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The
Geographical Journal.

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EXPLORATIONS IN PATAGONIA.*

By Dr. FRANCISCO P. MORENO.

The division of the continental waters takes place, without a doubt, between the river Belgrano and Lake Buenos Aires in the same conditions as further south, that is to say, in the Patagonian plateau or in its depressions. The present affluents of the southern part of the river Desire rise in the volcanic plateau itself, and run northwards to enter gorges covered by the lavas of the last eruption, that is to say, subsequent to the time in which the transverse depression was formed and eroded, and which unite the fjord of Lake Buenos Aires with the Atlantic. Arriving at this depression, they run through the centre towards the east, to lose themselves in small lagoons and large pools before gaining the Atlantic. The western plateau turns in this direction in the ordinary form of a raised headland, overlooking, on the south, the vast anterior bay of the lake, separated from the first mountains by the gorges by which the rivers Antiguos and Jeinemeni descend. More to the west the landscape assumes its fjord-like character. To the east, also, the plateau, on which craters can be seen, stops and opens in this direction, leaving a vast and lower expanse on which other more modern volcanoes rise, and which corresponds to the transverse depression formed prior to the eruption of these volcanoes, which protect with their lavas the smooth caps of Patagonian tertiary land. On the north side the table-land is free of lava, but capped by a considerable bed of shingle. What an enormous quantity of glacial detritus is found in this true *paysage morainique!* Certainly in no part of Patagonia are the moraines so well preserved. On every side enormous erratic boulders, quartzites,

* Continued from p. 269. Map, p. 352.

porphyries, and trachytes cap the undulations left by the moraines; and gneiss, for the first time, is seen amongst the detritus. In the flat cavities left by the retiring ice, small lagoons are seen, bordered by sand-banks; and springs, surrounded by rich pastures, abound. This ancient transverse depression has, to a great extent, been filled with volcanic ashes, which are visible in large layers, alternating with others of lacustrine and fluvial gravel.

Undoubtedly the transverse depression of Lake Buenos Aires is the largest in Patagonia. Since my visit in 1898, my fellow-worker, Mr. Waag, has succeeded in crossing the extremity of the lake and penetrating the river Las Heras which drains Lake Soler, into which Lake Buenos Aires flows. It is torrential and unnavigable. We thus have a further complete instance of the crossing of the Andean Cordillera by waters which rise to the east of it, taking advantage of the tectonic trenches, generally oblique to the axis of the main chain. All the transverse depressions of the Patagonian plateau correspond to large ancient fjords, the remains of veritable tectonic fractures, very probably produced by tertiary granite eruptions; and I think that the points at which the present rivers cut the chain are weak fractures which have been more easily and deeply eroded by the waters after the great masses of ice which covered and protected them had disappeared, and that this same melting process produced the wonderful erosions in the slopes of the Cordillera owing to the great quantity of resultant torrents. Lake Buenos Aires (985 feet) measures 75 miles in length from south-south-west to north-north-east, and is of similar type to the other large lakes mentioned—that is to say, partaking of the characteristics of both fjord and table-land lakes. In its extreme west it occupies a portion of the interior longitudinal depression which separates the main chain of the Cordillera from the isolated mountains. This depression stretches southward to Callen sound, and to the north it seems to extend a long way towards the eastern depression of the river Aysen, separating the cretaceous mounts Castillo and Ap Ywan (8625 feet) from the Cordillera proper. The west is overlooked by high snow-capped mountains, amongst them mount San Valentin (12,697 feet), with great glaciers. On the east the ancient outlet to the Atlantic is closed by modern volcanic ashes and fluvio-glacial detritus—first of all, those of the original moraine; and subsequently, those of the moraines left by the last extensions of the glaciers. In some parts of the western region the banks bear indisputable traces of the former level, and of its gradual and ever-increasing decline. These lines contribute to make the vast landscape, with its terraces and *roches moutonnées*, full of interest; and this is further increased by the picturesque calcareous islands, through which the waters have pierced their channels, converting them into so many *pots-à-arbre*. Springs, situated in beautiful prairies, are more abundant there than in the south, and it is certain

that within a short period the valleys lying between the eastern hills of the lake will be successfully made available for colonization. Last year I left a steam-launch there, by means of which the lake and its environs are now being carefully explored.

When delineating the aspect of the southern depression, and pointing out the present curious course of the Viscachas rivulet, I referred to the river Fenix. This river, rising in the Ap Ywan mountain, situated north of the centre of the lake, flows east-south-east for some 30 miles, and then abruptly turns to the west (1540 feet) to empty into Lake Buenos Aires. It runs between two lines of moraines marking the former extension of the last great glacier, which the lake subsequently occupied.

RIVER FENIX, NOW OVERFLOWING TO THE ATLANTIC AND PACIFIC OCEANS.

In consequence of one of the very common phenomena of capture to which these rivers are subject, the course of the Fenix has been turned towards the Pacific at one point from its ancient channel, and at such an insignificant level above low water, that, by working eight days with six men, we were enabled to send the waters back by their original channel to the Atlantic. This seems a practical demonstration of the fact that no mountains or hills existed there, and of the facility with which, by turning the waters in that direction, hundreds of miles could be easily colonized, which at present are regarded as useless deserts. If it was only when the ice melted in spring-time that the waters followed that course, to-day they have made it permanent. Lake Buenos Aires is merely a remnant of the enormous lacustrine deposit

which existed in this region in pleistocene and even recent times, as the first Spanish explorers who penetrated into Patagonia in the neighbourhood of Port Desire found rivers there which have since nearly ceased to exist.

Between the depression of Lake Buenos Aires and that of the river Senguerr, which drains Lakes La Plata and Fontana (3050 feet) to the Atlantic, another lacustrine depression exists, the waters of which have been drained off in part by the present channel of the river Aysen when once the breach was opened in the central chain of the Cordillera. The wide and deep valleys of Huemules, Mayo, and of Coyet once belonged to it, and their drying-up is due to the same general causes already mentioned—the accumulation of glacial deposits, the decrease of waters through decrease of rains, and the increase of evaporation, as well as to the uplifting phenomena.

In 1888 I sent an expedition to study that region. At that time the Blanca lagoon, which was almost the sole remains of the lake in the valley of the Huemules, drained to the east into the Chalia rivulet, an affluent of the river Mayo. It has now ceased to flow in that direction, and, as the erosion is greater on the west, it is probable that the waters from its basin will in future run towards the southern affluent of the Aysen, and will be tributaries to the Pacific ocean.

In the river Mayo I have seen springs of the river Coyaike, the central affluent of the Aysen, rise in the same source as those of this river in the transverse depression, which is narrowed there by modern volcanic rocks; and identical phenomena are produced close to it in the Coyet depression, where it is impossible to distinguish the point at which the waters separate in the two directions in the great depression of this name, and in that of Cantaush. The shores of the great lake are perfectly visible there; they are the remains of a much larger one, which extended as far as the present basin of Lakes Musters and Colhue, in the neighbourhood of the Atlantic, and the probable outlet of which was in the present Gulf of St. George. This eastern basin of the present Aysen is bordered on the west by the central chain of the Cordillera which is formed of high granitic mountains with large glaciers which considerably add to the waters of the river Aysen. It is bordered on the north by the Jurassic and Cretaceous hills which enclose Lakes La Plata and Fontana on the south. In this depression there are beautiful workable lands, and really picturesque landscapes abound, with open woods situated in the midst of beautiful prairies.

Lakes La Plata and Fontana occupy a fjord of another ancient great eastern lake, and have their outlet in the river Senguerr, which fed the river Chico of Chubut—that is to say, the southern affluent of the river of this name. I say "fed," because its waters ran to this river up to 1892, but since then the outlet is probably subterranean, as, according to the Indians, the water of the river Senguer has not decreased during the past seven years.

CORDILLERA OF THE ANDES, NORTH-WEST AND WEST OF LAKE BUENOS AIRES.

Lakes Musters and Colhue are now without outlet, and are themselves the remains of a much larger one, likewise part of the great pleistocene lake the depression of which is seen to the south of the present ones. According to my data, a great depression exists in this direction, with saline lakes.

Lakes La Plata and Fontana are situated at a greater altitude than Lake Buenos Aires, this being a repetition of the case of Lake Belgrano with respect to Lakes St. Martin and Pueyrredon; they are surrounded on the north and south by hills composed of similar cretaceous rocks, containing similar fossils; while on the west they are bordered by the granites of the central chain, and moraines enclose them on the east. The Katterfeld mountain, situated on its southern shore (5900 feet), is covered on its summit with glacial gravel. In the north the hills advance more to the east than in the south, and are composed, in the neighbourhood of the plain, of volcanic rocks, which at times cover cretaceous schists, and enclose beautiful valleys. We have discovered there numerous cretaceous fossils, both animals and plants, and coal has been observed.

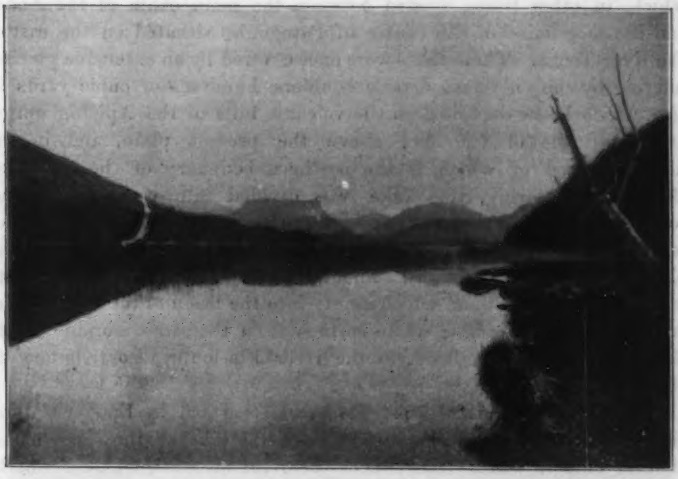
The plain extends between these hills and the central ridges of Patagonia, at the base of which the river Genua flows towards the south to join with the Senguerr. These chains are composed partly of tertiary granite and porphyritic rocks, and partly of beds of upper cretaceous, probably containing saurian and mammal remains. This plain also forms part of a great lost lake which extended to Mounts Appeleg, Omkell, and Cherque, cut by the narrows through which, in ancient times, another lake drained, now also lost. It was situated between the hills to the north of Lake Fontana and the Putrachoique hills, in which depression, at the present time, the continental waters divide themselves amidst perfect morainic landscapes. This country is very suitable for colonization. While the waters which flow eastward empty, *viâ* the affluents of the river Genua, into the Senguerr, those to the west cut the Cordillera with the rivers Frias and Cisne, which empty into the Payuhuapi inlet on the Pacific coast, and with the river Pico, which feeds Lake Rosselot, which seems to occupy the continuation of the Payuhuapi depression, and drains into the river Palena, forming its principal southern affluent. The landscape seen from the highest point of the moraines (3600 feet) in the centre of the depression is interesting. To the east the mountains of Genua, rounded by the ice, which mountains are prolongations of the Sierras de Tecka, corresponding to a chain in the centre of Patagonia; while far to the west, only visible when the horizon is clear, the snow-capped crests of the Cordillera are seen; and yet nearer are the undulating forest-covered hills. A great number of terraces, forming depressions with fertile valleys, are indications of so many distinct levels; first of the waters of the primitive lake, then of the secondary

PENINSULA SAN TADEO, AT LAKE NAHUEL-HUAPI.

lakes, and finally of the rivers which have disappeared, and which are now converted into streamlets, hidden for the most part amongst woods and tall grass, which impede the traveller. Gravel detritus, presenting all the characteristic forms of its origin, covers the ground, the huge erratic boulders showing the great height attained by the ice and the waters of the lost lake.

Crossing the hills uplifted by modern volcanoes, the materials of which were ejected through the weak places produced by eruptions of tertiary granite which is seen in round patches on the sides of the present eastern valley of the river Carren-leufu, we reach this valley, along which the central affluent to the river Palena flows. This affluent rises in Lake General Paz, which is similar in structure to the others (2820 feet), and the waters of which are confined on the east by the ancient basal moraine, and by the moraines of the later extension visible in vast semicircles. My assistants are now examining the interior of the lake with its various fjords, into which glaciers descend, and which are surrounded on the south-east by tertiary granitic hills, polished as whale-backs by ice, and by cretaceous schists and more ancient eruptive rocks on the west. The river Carren-leufu, after following at the outlet of the lake an east-north-east direction, turns to the north, and then to the north-west with a pretty wooded valley, to cross, in an east-west route, the main Andean chain, and empty, through the river Palena, the river Claro originating in Lake Rosselot, and the river Frio, an important affluent which flows from the north in a longitudinal depression close to the Pacific. This depression corresponds to that of Lake Rosselot, a depression which separates two high ridges of the snowy Cordillera culminating in Mounts Maldonaldo, Serrano, and Blanco on the eastern, and Melimoyu (8650 feet), Corcovado (7450 feet), and Yanteles (6725 feet) on the western. The river occupies, in its eastern third, the same longitudinal depression which extends from the south, separating the mountains from the terraces; the rims of the Patagonian terraces are seen on the east, and cretaceous and modern eruptive rocks on the west, while the valley is filled with glacial detritus. If this depression is followed towards the north, separated by a remnant of moraine, the beautiful valley of "16 de Octubre" is reached, the present location of a prosperous Argentine colony. This valley is only the bed of another dried-up lake, the remains, in its turn, of another much larger one, the lines of level of which can be easily distinguished on the slopes of the neighbouring hills. It is to-day sinking in the morainic terraces; its waters once flowed, at least those of its last depression, into the river Fta-leufu, which has been lately recognized to be the same as the river Yelcho, that drains to the south of the Reñihue inlet into the Pacific. To the north-east of the Carren-leufu plateau there are certain eruptive and volcanic rocks which

have broken up the ground, forming the high hills of the west of the present river Tecka, and which is surrounded on the east by the longitudinal depression which precedes the first ridges of the Cordillera. The Corintos rivulet rises in these hills, and has the reputation—though this is not thoroughly established—of possessing auriferous deposits, the upper lacustrine basin of which is the most appropriate for the study of the terrace-levels. I have counted twelve perfectly defined steps there. Before the opening of the Carren-leufu and Fta-leufu narrows, this basin was connected with the Atlantic on the east, draining through the river Tecka, on the shores of which perfectly distinct traces of level are seen. At the present time, at the bottom of the ancient channel



LAKE VIDAL GORMAZ, FORMED BY ALLUVIAL FANS IN THE SOUTH-WESTERN ARM OF LAKE NAHUEL-HUAPI.

of the outlet, waters rise which flow to both oceans, separated in the Zunicaparia swamp by a ledge of shingle not more than 30 feet higher than the present streamlets.

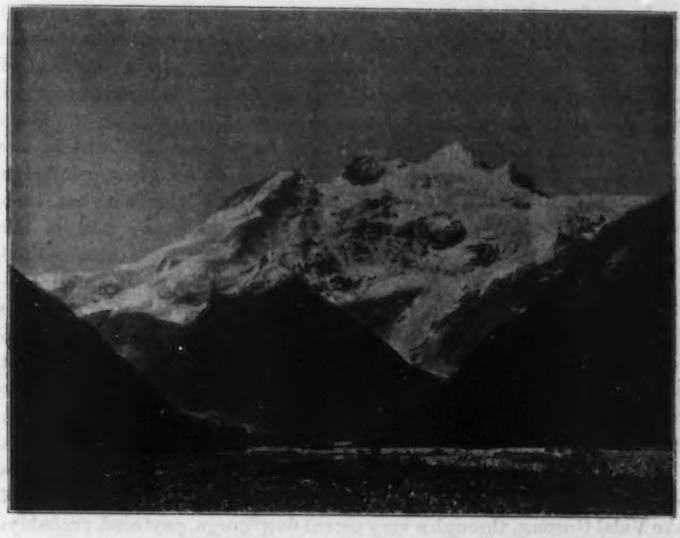
I have said that the river Fta-leufu at present receives the waters of the valley of "16 de Octubre" (1085 feet). It also receives those of a vast northern area now bordered by moraines separating the waters which empty into Lake Cholila (1705 feet) from those flowing to Lake Puelo (560 feet), which, in its turn, flows through the river of the same name into the inlet of Reloncavi on the western coast of the continent. This opening, which separates Situation mountain (6690 feet) ridge immediately to the west of the valley of October 16 from the lateral chains of the Cordillera proper, contains a series of

beautiful lakes, the principal ones being Ftalauquen (1560 feet), Menendez (1590 feet), Rivadavia (1640 feet), and Cholila, which are chiefly fed by waters from the glaciers of the central chain, called the secondary chain by some Chilian geographers, and on the western slope of which various important rivers, tributaries of the Pacific, rise, such as the Corcovado, the Reñihue, the Bodadahue, etc. That chain, which I consider as the main chain of the Cordillera, extends from Fontana lake to the north, and joins the one which is overlooked by the beautiful Mount Tronador on the west of Lake Nahuel-Huapi, being cut by the rivers Cisne, Palena, Yelcho or Fta-leufu, Puelo, and its affluent the river Manso. The lakes named, supplying waters to the river Fta-leufu, are the remains of fjord-like arms of the great lake which, in other times, existed between the main chain of the Andes and the mountains of the centre of Patagonia, situated on the east of the river Tecka. These lakes were once covered by an extensive glacier, judging by the enormous erratic boulders, hundreds of cubic yards in size, which I saw deposited on the volcanic hills of the Apichig gorge, at an altitude of 650 feet above the present plain, and in the neighbourhood of which is the northern boundary of the lost lake. Before disappearing, this lake was divided into various fractions, separated to-day by glacial deposits; and in its depressions another secondary parting of the waters of the continent was formed. In the plain of Cholila, the northern affluent of the Chubut flows on the east; and the waters rise there which empty into the basin of the river Puelo, tributary of the Pacific; while springs from the same moraine reach, through the southern lakes, to the river Fta-leufu, also tributary to the Pacific.

To the north of this depression, and separated by Epuyen lateral ridge, cut in its turn by the waters of the lake of the same name, another one, in which Lake Puelo occurs, is situated, which formerly extended to the vicinity of the southern fjords of Nahuel-Huapi, but is now divided into two parts. The waters of the southern one emptying into Lake Puelo, to quit it in the turbulent river flowing to the Pacific by the narrow gorges of the main chain of the Cordillera, while the northern one feeds the affluents of the river Manso, which also traverses the main chain to flow to the river Puelo.

I have pointed out that the ancient lake of the depression of the valley "16 de Octubre" emptied in a previous epoch into the Atlantic *viâ* the river Tecka, now an affluent of the Chubut. To the north of the ancient channel stretch a series of hills separating a secondary longitudinal valley, situated on the east of the Esguel and Lilig hills, which was also the bed of the same lake; this is easily recognized by the strata which are observed in the cuttings of the streams that at present cross it transversely. This depression extends northward to unite with that of the northern arm of the Chubut, and is separated

from the latter by an extensive moraine reclining on a volcanic hill. The northern arm of the Chubut penetrates through the continuation of the longitudinal depression, also crossed by deep transverse gorges, outlets of the different levels of the ancient lake as it shrank its proportions. It extends to the north until it reaches the high plateau which separates the depression of the river Chubut from that which corresponds to the river Limay; and, likewise, another transversal valley, in which at a previous epoch existed the river carrying the waters of the Nahuel-Huapi to the Atlantic by the present San Antonio bay. This plateau, also formed by different terraces, and covered with the remains of the glacial period as far as the western



MOUNT TRONADOR, IN THE MAIN CHAIN OF THE CORDILLERA.

hills, overlooks the entire eastern depression of the river Manso, which separates it from the lateral ridges that precede the veritable Cordillera, and various springs rise in it—some affluents of the Chubut, and others of the basin of the Nahuel-Huapi lake. It has, on its western edge, a chain of cretaceous hills, which in some parts attain an altitude of 7000 feet, with peaks consisting of a porphyritic rock, which, mingled with the dark grey of the schists and the green of the trees of the surrounding forests, gives a vivid colouring to the mountain.

The descent from the plateaus to the plain of the ancient extension of Lake Nahuel-Huapi is rather long, and on its sides erratic rocks abound, which are not generally found at the bottom of the depression,

except in the deposits that correspond to the second advance of the glacier, the last moraine of which surrounds the present lake, which undoubtedly is the most beautiful in Patagonia. If the present extension of the lake is great, and its western channels penetrate to the heart of the Cordillera, this extension was, in a relatively recent period, much greater. The series of small lakes I have referred to, which now empty into the river Manso, are remains of arms of Lake Nahuel-Huapi. The waters of this extended, in recent times, to the present Limay narrows on the north, and washed the base of the Cordillera nearly to Lake Traful; in the south they filled the fjords where Lakes Vidal Gormaz (2330 feet), Guillelmo, Mascardi (2570 feet), Gutierrez (2575 feet) and others smaller, are found to-day; and on the east they filled all the depression of the present valley, discharging, not as at present through the recent gorge through which the Limay flows, but through the still existing transverse depression that terminates at the end of St. Matias gulf, called the Bay of San Antonio. The eroded terraces and the erratic boulders which I have mentioned as being on the slope of the plateau indicate that extension. At present the waters are diminishing, either through erosion having produced greater drainage outlets, decrease of rains, or evaporation, so that the lake has been divided; but in its extreme north-west its remains are seen in the beautiful Lakes Espejo and Correntoso, which occupy the longitudinal fjord peculiar to all the great Andean lakes already named, and separated from the present Nahuel-Huapi by small alluvial cones; on the extreme west similar lakes are seen in another ancient fjord. In the south-west, Lake Gutierrez, situated at an altitude of about 150 feet above the present Nahuel-Huapi (2430 feet), primarily formed by the terminal moraine of the glacier of the fjord, is only separated by a cone of sediment 50 feet high from Lake Mascardi, likewise the remains of the same fjord. While the first discharges into the same lake, the second has its outlet to the west and south after receiving the waters of Lake Vidal Gormaz, through a very recent deep gorge, produced, probably, in part by volcanic phenomena, until it encounters the eastern valley of the river Manso. The ancient fjord south of Lake Nahuel-Huapi previously penetrated slightly more to the west than the present arm of Port Blest in the same central chain, at the southern base of Mount Tronador, which chain extends to the south, separating the waters that fall into Lake Gormaz from those forming the river Cochamo, which discharges directly into Reloncavi inlet. Mount Tronador, the king of this part of the Cordillera (10,860 feet), distributes the waters of its glaciers to Lake Nahuel-Huapi and Todos los Santos, its western congener. The river Limay is now the outlet of Lake Nahuel-Huapi, its course having pierced an outlet into the ancient valley of the lake, and joined the ancient river which collects also the waters of the northern longitudinal depression in part. The rivers Caleufu and

Chimehuin are affluents to the river Collon Curá, which carries to the Limay all the waters of the eastern Andean slope from parallel 37° 30′ through the continuation of the general eastern depression. The character of the region is generally the same as in the south. Lake Traful, which discharges into the Limay by the river of this name, occupies one of the many transverse fjords already mentioned. It is deep, like all the Andean lakes, and very beautiful with its picturesque granitic and volcanic mountain groves and wooded islets, overlooked on the west by the central chain, and on the east by the terminal moraines of the ancient glacier.

VOLCANIC TUFF AT RIVER LIMAY.

The river Caleufu carries the waters of the lakes Villarino, Falkner, Filohuehuen, Hermoso, and Metiquina to the Collon Cura; while the river Chimehuin no longer receives all those of the east Andean slope. In relatively modern times, between the Sierras de Chapelco and de la Virgen, a great lake existed, the present remains of which are Lake Huechulafquen (2820 feet), in which the beautiful cone of the Volcan Lanin (12,140 feet) is reflected, and the lakes Lolog and Lacar. To-day only the two first named discharge into the Atlantic; the third, which emptied on the east into three rivers, the beds of which are perfectly preserved, is, on the contrary, a tributary of the Pacific, its waters turning into the river Huahuma, which has cut through the main Andean chain, which is there called the Cordillera de Ipela (7500 feet). An altitude of scarcely more than 5 to 10 feet at the base of a moraine

separates the waters of the river Quilquihue, the outlet of Lake Lolog (2920 feet), from those of the Calfuco stream, affluent of Lake Lacar (2200 feet); and at that point, at the base of the remains of the plateau, a spring exists, which sends water to the two streams.

The valley of the Chimehuin is already the seat of a prosperous township, Junin de los Andes (2560 feet), which will become the emporium of the riches of those regions so soon as a sufficient population arrives to exploit them, and the trans-continental railway is constructed on the route indicated by Captain Fitz Roy in 1834 as being the easiest means of communication between the Atlantic and the Pacific, which is that of Puerto San Antonio, on the Bay of St. Matias.

The region in the neighbourhood of Junin de los Andes, watered by the rivers Chimehuin and Malleco, is one of those which has the best future before it in the Neuquen territory, in Northern Patagonia. It possesses extensive pasture lands, the Araucaria forests beautify its landscapes with their fantastic foliage, and strawberries abound in the proper season, amongst the apples introduced in very early times. On the west, projecting over the lower mountains, are still active volcanoes, such as the Lanin (12,140 feet), whose glaciers diminish from year to year; the Quetrupillan (9185 feet), with its truncated cone; and the Villarica (9675 feet), picturesque in its forest groves. As one advances northward, after passing the high primitive plateau of Pichi-Nahuel Huapi, one finds verdant valleys with charming lakes, gorges cut through the granitic rock, capped with lava, offering a most beautiful and varied prospect—the green prairies alternating with the forests. The river Alumine receives the waters of these lakes, as well as of the torrents and those of the picturesque lake of the same name, which penetrates to the heart of the Cordillera, and is surrounded by characteristic moraines; while on the east abrupt fields of lava are in the Catalin ridge—an independent mountain, which forms no part of the Andean Cordillera. The northern affluents of the Aluminé are separated from those which form the river Bio-Bio by a tall moraine (4580 feet) of the ancient lake which occupied the eastern depression of the Bio-Bio when its waters ran into the Atlantic, before the opening of the cañon through which it now empties into the Pacific. It is a region of great interest, from various aspects, about which, however, I must not say more now, as it would be foreign to the object of this lecture.

To conclude this lecture, the extent of which prevents me going more fully into details, I think it advisable to give the following summary:—

Starting from the Atlantic coast, we find in Patagonia a denuded tertiary and sometimes cretaceous table-land extending from the Rio Negro to Magellan Straits, interrupted in its geological uniformity

by the ancient eruptive rocks and archean schists of San Antonio, Point Atlas, Santa Helena, and Port Desire, which are the effects of analogous formations from further inland, and constitute the almost obliterated central chain of Patagonia, the remains of which are Mounts Calgadept, Talaguepa, and Los Martires, and those near Lake Musters. This plateau is cut by large transverse depressions, the principal being the Hualichu depression on the south of the Rio Negro, the Maquinchau and Balcheta, through which previously emptied the waters of Lake Nahuel-Huapi, the present Chubut, Senguerr, Chico, Desire—ancient outlet of Lake Buenos Aires—to-day nearly exhausted,—the

VOLCANO LANIN, FROM THE VALLEY OF THE MALLECO.

analogous river Gio, which is between the Desire and the totally disappeared river San Julian, which has connected probably Lake Belgrano, by the river Chico, with the Atlantic; the depressions of Lakes San Martin and Viedma, the river Shehuen, the Santa Cruz, the Coile, and the Gallegos.

Besides these transverse depressions, which are now, or were, occupied by large rivers, other depressions are found in the plateau, which were occupied by more or less extensive lakes, having their outlet through these transverse valleys, such as the Yagagtoo, Musters, and Colhue, and others situated on the south of Port Desire, in the centre of the country.

These plateaus are covered, on the greater part of their surface, by a cap of loose glacial, and in some parts by fluvio-glacial, gravel, which

barely supports the growth of some coarse pasturage and a few bushes on the shores of the northern rivers. At the present time, good pastures are only found on the watered lowlands, where bushes are more numerous, but, by irrigation, extensive lands can be cultivated in the whole of the country. In the central region, volcanic eruptions, which have taken part in the formation of the plateau, from the tertiary periods down to the present era, cover an important part of it with basaltic lava-caps; and in the western third recent glacial deposits appear even above the lavas. The plateau terminates at the base of the first lateral hills preceding the Cordillera of the Andes.

There, in contact with folded cretaceous rocks raised by the tertiary granite, erosion, produced principally by the sudden melting and retreat of the ice, aided by tectonic phenomena, has scooped out a deep longitudinal depression, which generally separates the plateau from the first lofty hills, while on the west of these—which generally form small ridges or isolated hills—a similar longitudinal depression is observed which precedes the veritable Andean Cordillera. This depression contains the best and most fertile lands of Patagonia. The geological constitution of the ground is in accordance with the orographic physiognomy. The tertiary plateau, horizontal on the east, gradually rising on the west, shows upper cretaceous caps at its base. The first lower cretaceous hills, raised by granitic and dioritic rocks, probably tertiary, and then, on the west, metamorphic schists of uncertain age; then quartzites appear, resting directly on the primitive granite and on the gneiss which form the axis of the Cordillera; while porphyritic rocks are seen between the schists and quartzites. All these rocks are covered with the remains of the ice-period, which are not only observed in Patagonia, but also in the whole western region of the Argentine Republic. I have seen moraines and glacial lakes on the Puna de Atacama, and on the mountains in the province of Salta as far as parallel 23°, and I have found perfectly characteristic ones in the provinces of Catamarca, Rioja, San Juan, and Mendoza. There the glaciers have descended to the level of the present plain (2400 feet). The glaciers occupy the valleys of the main chain and some of the lateral ones of the Cordillera. Many, on the west, descend to the sea to lat. 44° 30′, and, on the east, to the lakes, strewing them with icebergs; while several of the high peaks are still active volcanoes, among which I should mention three little known—one situated to the west of Lake Dickson, according to the Indians; another, the Fitzroy volcano; and the third was seen from the Argentine vessel *Azopardo* from the sea, in about lat. 47° 30′.

In Patagonia an immense ice-sheet extended to the present Atlantic coast, and further east, during the first ice-period; while, during the second, terminal moraines have been generally left as far as 30 miles north and 50 miles south to the east of the present crest of the Cordillera. These ice-sheets, which scooped out the greater part of

the longitudinal depressions, and appear to have rapidly retreated to the point where the glaciers now exist, did not succeed in filling with their detritus, in their rapid retirement, the Cordilleran fjords now occupied by deep lakes on the east and by the Pacific channels on the west. Soundings taken in these channels (which have reached 250 fathoms in some fjords) show that the depth of these fjords is greater in the vicinity of the mountains than to the west of the islands; and probably a longitudinal depression exists there analogous to the one which preceded the plateau on the east, and limited by a submarine plateau to the west.

It is evident to me that we have in Patagonia a portion of the Antarctic continent, the permanency of which, in so far as its main characteristics are concerned, dates from very recent times. When, lately, I went through the western, *i.e.* the Pacific channels, my attention was directed to the islets in close proximity to Chiloe—between that large island and the Cordillera—they appeared to me to be of very recent emersion, and I recalled Darwin's interesting observation, when he noticed that, in Chiloe, various promontories, joined by extensive beaches to the mainland of the island, are called "huapi," the Araucanian equivalent for "islands," thus perpetuating, perhaps, the recollection of the time when they were islands. Those of the islands I was able to see were composed of caps of shingle, with great, more or less rounded, boulders, of sand and volcanic ashes, essentially of the same form as some of the remains of the Patagonian plateau.

To those who have studied the pampean formation, it is well known that the actual land of the Buenos Aires province must have extended eastward in recent times, and that the advance of the sea, and the salt-water deposits left by it when it retired, forming some of the lowlands which are seen on the littoral and even in the interior of the pampas, are much more recent. Likewise certain caps of shingle derived from rocks of a different class to those of the neighbouring hills, which are observed on the Atlantic coasts of the same province, increasing in quantity and size as one advances southwards, seem to indicate that the caps of shingle which now cover a great part of the Patagonian territory extended more to the east on emerged land which has now disappeared; while other marine deposits seen on the same coast appear to have been turned into bays during the subsequent advances of the sea. Besides, in the neighbourhood of the present coast, even in the very province, deposits of volcanic ashes are found; and the ocean deposits on its shores blocks of basaltic lava, which probably proceed from eruptions of volcanoes now under the sea, similar to those to which I have referred in Patagonia. But one of the facts which seems to me to demonstrate with greater certainty the existence, in recent times, of land now lost is the presence of the remains of the pampean mammals in pleistocene deposits in the bay of San Julian, discovered by Charles Darwin, and

in Santa Cruz, where I have myself gathered them. These animals lived there in the intermediate period between the great ice extension of the Patagonian inland ice and the second period, and, undoubtedly, reached that point from the east, as it is not presumable that they advanced from the north to the south over the plateau cut by the great (now lost) rivers, all of which contained ice in abundance. The presence of extinct animal remains in Patagonia in the vicinity of the Cordillera, demonstrated by the discovery of the skin of the so-called *neo-mylodon* in the cave near Last Hope inlet, to which reference has already been made, may be explained, I think, by supposing that the animal to which this piece of skin belonged penetrated from the east to the neighbourhood of the Cordillera in the intermediate period between the two glacial extensions, the piece of skin being preserved till now, owing to the favourable nature of its surroundings.

So, then, the history of the Patagonian plateau is connected with the problem of the southern continent, which, to so great an extent, has disappeared. The discovery in its geological caps of vertebrates closely allied to others found in South Africa, and Australia; the large fossilized tortoises of the province of Buenos Aires, analogous to those found in the islands of the Indian ocean and in the Galapagos; the discovery of dicotyledonous plants in the Andean cretaceous formations, among others, apparently, remains of the eucalyptus—are all in favour of those who maintain the existence of those lands and their disappearance in recent times. It is known that the Patagonian tertiary formations—abounding in mammalian remains—are, in their major part, lacustrine deposits, formed of sand, caps of gravel, and volcanic ashes; but the great lakes which these deposits formed were extended to the east, as is demonstrated by the cliffs of the Atlantic coast, and as these deposits occupy the greater part of the present Patagonian territory, it may readily be admitted that when those animals lived, the continent had a very much greater extension in that direction.

The whole of this vast region of Patagonia is very thinly peopled; even the Indians, never very numerous, are dying out, and colonization has not progressed as it should have done, seeing that land exists there which would support a considerable number of human beings. However, in the neighbourhood of the river Gallegos, numerous cattle farms have been established, and the cattle are developing admirably; Gallegos city consequently prospers. Also in Santa-Cruz the village grows rapidly. To the north of the river Chubut valley, where, in 1865, the Argentine Government formed a colony with Welsh settlers, the soil has been fully developed, the finest wheat of the Argentine Republic being grown there. Another colony is situated in the valley "16 de Octubre" near the Cordillera; while in other parts of the territory, cattle estates are met with, which are being successfully developed, principally in the neighbourhood of the Gulf of Saint George. The Argentine

Government has now turned its attention to the southern lands of the Republic. All danger of international complications having disappeared, the first step of the Government was to exchange contracts for war material, amounting to over a million pounds sterling, into contracts for railway material for immediate use in the construction of the projected line of railway between the Atlantic and the Andes, starting from the port of San Antonio, which was considered by Captain Fitzroy, early in 1834, as the best route for communication with Chile; while surveys for irrigation works are being made at this moment, and plans for irrigation are now being elaborated which, when completed, will easily change the desert aspect of a large portion of Patagonia.

WOOD OF ARAUCARIA IMBRICATA.

And it is very satisfactory to learn that on June 1 the great southern line will be opened as far as the junction of the Limay and Neuquen rivers with the Negro river on its way to Nahuel-Huapi, the most lovely lake in South America. Here and there the traveller finds a Tehuelchian or Gennaken encampment, but natives of pure race are now very scarce; it would be difficult to gather together fifty true Tehuelches, and the number of Gennakens cannot be much greater. The remaining native population is composed of the ancient Araucanian race, or a mixture of the three races. But these do not represent the only type of human beings which have dwelt in Patagonia. In ancient burial-places I have collected the remains of other—now totally disappeared—races, which were quite distinct from the present ones, but which greatly resembled the primitive types met with more to the north,

in the Chaco and in Brazil, while others strongly resemble some Pacific races, possessing ethnic characteristics which have not been observed in South America. Among these remains, every type of artificial deformity of the skull hitherto known is found; while to-day the natives only preserve the occipital deformation. This variety of extinct human types should of itself form the subject of a serious investigation. Patagonia is the extremity of the American continent, and has been the last refuge of more than one people in their forced exodus. For the purpose of study, I have handed to the staff of the British Museum, duplicates of the extinct and present animal remains of Patagonia, and of its flora, which I collected in my excursions, as well as of those obtained by the *personnel* of the La Plata Museum, of which I am the director; and I trust that, with such competent collaboration, it will soon be easy to give an exact idea of Patagonian biology, of which I must not treat at this meeting.

The physiographical facts which I have sketched in broad outline show how interesting the lands of Patagonia are to the geographer, the geologist, the zoologist, and the botanist.

I do not think I shall be accused of exaggeration when I say that the study of the extremity of South America, where Charles Darwin received the first impressions of his grand ideas, and which, nevertheless, has since been so neglected by English scientific men, is, among the less-known regions of the Earth, one of those which should awaken the greatest interest. The Argentine Republic, owning the chief part of this territory, as a new country, does not yet possess a sufficient number of persons for carrying out the investigations I have alluded to, and would welcome those who might go there for the purpose of such studies. I have no doubt that both the people and the Government would efficaciously co-operate to make their visit a success. The climate is healthy; there are no great difficulties in travelling in the country, even in its most unknown regions, and, with that perseverance which is inseparable from true knowledge, the results which would be obtained would be extraordinary. So I take the liberty of proposing that our Society, with the co-operation of the British Museum, the Royal Society, and other institutions which take interest in this class of studies, should procure the means of realizing these investigations. It is to be desired that, at the time at which the Antarctic Expedition takes place, a complimentary one should be despatched to the Argentine Republic with the object of studying its territory, seeing that it cannot be extraneous to that of the antarctic regions; for already many persons think that these regions are the remains of an extensive continent which, in more or less distant periods, included, among others, a part of the Argentine territory. Perhaps a brief statement of some of the points to be investigated would show how great the need was for it.

A great part of the extension of the Andean Cordillera is completely

unknown, both as to its topography and its geology, and yet its study is of the utmost importance, in view of the problems, the solution of which depends upon it. It is not hazardous to say that the ideas current with reference to its formation and constitution do not correspond with the facts, and I will say the same as to other mountainous regions of my country. Very few countries are more appropriate for the study of vulcanism and the movements of the Earth's crust, the activity of which now causes constant tremblings, which are felt up to the eastern regions of Bolivia, producing tectonic phenomena requiring immediate study.

The formations of the plains of Argentina, of its renowned Pampa, and of the Patagonian table-lands, are problems still waiting solution, and claim the direct attention of experienced observers, as well as an investigation into the origin and development of the animals and plants —principally of Patagonia—the fossil remains of which have so greatly interested palæontologists, who anticipate that they will fill up many of the great gaps existing in the knowledge of the vital evolution in the Earth.

Much new material for zoologists and botanists would result from the exploration of the mountains and woods in the north of the Republic, and of those of Patagonia and its coasts; the fauna of the Andean lakes is still a mystery.

Physiography has much to gain from the study of the process of the formation of the present features of this part of the Earth; it would be difficult to find another country where the action of the ice could be so easily studied, as well as the phenomena of erosion and denudation.

Those who are engaged in the study of the past history of mankind, would find an ample harvest of new data—many of them unforeseen—which would open out vast horizons, by exploring the vestiges of lost or nearly extinct races—some half civilized, others nomadic, which can still be found in the Atacama high lands down to the end of the continent.

And, finally, those who desire to investigate with that personal knowledge of the ground which so greatly strengthens one's convictions, the economic value of the physical conditions of that territory, will receive compensation for their labours in being able to say that human energy possesses there a vast fertile field for its exercise.

Science would gain much from this class of investigation; industry and commerce would profit thereby; and—why should I not say it?—my country also, which is to-day engaged in effacing the errors of the past, would gain in every way, when once unbiassed men, accustomed to observation, give expression to their opinions as to the nature of its soil, and as to what it might be expected to sustain if properly exploited. It seems to me that investigations carried out in this way would have a practical result in every sense of the word.

Before the reading of the paper, the PRESIDENT said: This evening we are to hear a most interesting paper from Don Francisco Moreno, the great South American geographer and geologist. About two years ago I wrote a paper for a magazine in America, on the subject of the countries which have not yet been discovered, and I put a long black mark along the eastern side of the Patagonian Cordillera. That black mark has now to be removed. Don Francisco Moreno has since brought the news to us of his important discoveries in that region; he has also brought a great number of maps and most beautiful photographs of the country explored, and he has communicated to us a very full and very valuable paper, which will be printed in our *Journal*. This evening we can only have a brief abstract of that paper, and Señor Moreno will show us a number of his photographs.

After the reading of the paper, the following discussion took place:—

DON FLORENCIO L. DOMINGUEZ, Minister of the Argentine Republic: I thank you most heartily for the kind words in which you have introduced the name of my country, and for the cordial reception given to Señor Moreno. The Royal Geographical Society, which has so many titles to the consideration of the learned men of the whole world, is looked upon in the Argentine Republic with genuine sympathy for the interest it has always shown in the investigation of the features of a country which offers so many natural attractions to the traveller and such a wide field for scientific investigations. The learned President has shown in his works a thorough knowledge of the South American continent and true sympathy for the efforts of their sons in developing and making known the vast resources of their own countries. As to my own country, this is not the first time that he has spoken kind words. It has been my pleasure to listen to him in similar circumstances as those that have gathered us here to-night, when a fellow-countryman of mine, an officer of our navy, gave an account of his travels in the wild regions of the Rio Bermejo; and not long ago, only last year, in welcoming an English traveller after his gallant attempt to climb Aconcagua, he spoke in eloquent words of General San Martin's memorable achievements in crossing the Andes with an Argentine army in order to complete the liberation of two sister republics. Sir Clements has followed with kind interest the explorations of our own travellers, the works of our writers, and his opinions are the result of his deeply rooted convictions.

The Argentine Republic, as a whole, is not unknown in Great Britain. Our commerce is of great importance; we receive from the United Kingdom far more merchandise and products of the industry of her people than from any other country, and in exchange Argentina sends to this hospitable land the natural products of her soil and of her camps, which contribute in some extent to the well-being and comfort of the sons of this great empire. There are in the museums and other institutions of this country many objects which show the Argentine Republic under a scientific aspect, but there are, however, portions of the country which contain, perhaps, unravelled features and secrets worthy of investigation by those whose aim is the expansion of human knowledge. We have always welcomed those men, and it is our invariable rule not only to keep an open door, but to give free access to our territories to all those who, seeking a high ideal, come to our shores in search of new elements, to irradiate after the light they have gathered. The name of Darwin, not to mention any other, will always be fresh in the memory of the Argentines.

Dr. WOODWARD: I can only testify to the great advantage which the British Museum has derived from Dr. Moreno's generous assistance, in presenting to the natural history branch of our museum numerous objects from Patagonia and from the Argentine Republic generally. As you are aware, sir, he is the Director of the

great museum at La Plata, and those who have visited that museum can testify to the splendid work he has carried on there, in addition to the enormous labours, which you can judge by the character of his paper to-night, he has expended on this vast region of Patagonia.

From the geological point of view, no doubt there is no country that has been under exploration of late years offering so grand an opportunity to the geologist and geographer; the lakes, plateaus, and river systems must afford enormous fields for investigation in pure geological work. But more interesting to us, who are connected with the museum, are the wonderful Tertiary and Cretaceous deposits, containing such a remarkable fauna of both mammals and birds. This region was touched upon so long ago as the forties by Charles Darwin, and visited at various points by Admiral Fitzroy. Since that time very little exploration has gone on until now; we have laid open all at once a region rich in a new mammalian fauna, which will probably result in an extraordinary extension of our views as regards the geographical distribution, in Tertiary times, of the mammalia of the Southern Hemisphere. That we find in a region like Patagonia evidence of mammals which have their relations in Australia seems an extraordinary thing; but it is not improbable that some marsupials, which have been discovered in these Tertiary deposits of South America, may be related by descent with those of Australia, and therefore, in connection with what Dr. Moreno has said in regard to the importance of Antarctic exploration, it is quite justifiable to add the exploration of this region to that of the Antarctic; because it is possible, and strongly believed by many naturalists, that there may have been a former connection between these lands and the antarctic continent and the lands on the other side of the hemisphere.

With regard to Dr. Moreno's work in connection with geology, I have said sufficient to point out the great obligation we are under to him in making known and bringing examples of these various forms of animals to our museum. We have had visits paid to the La Plata museum by Mr. Lyddeker, Mr. Arthur Smith, Mr. Woodward, Mr. Oldfield Thomas, and others, and I hope we may look forward to closer inter-relationship between the Argentine Republic and this country, which will be of the greatest service in the promotion of natural science generally.

Dr. Gregory: I have had the pleasure of reading the paper, and therefore have much pleasure in joining in your tribute to its great importance to Patagonian geography. At this hour of the night it is not possible even to refer to all the points upon which it throws light. I might perhaps mention three.

First, the probable connection of Patagonia with the antarctic continent, which renders it necessary that its natural history should be worked out before the collections from the antarctic expedition are brought home; as otherwise it will not be possible to get great results from these collections.

Second, there is the question of the relations of the fauna and flora of Patagonia with those of Australia and the Cape.

Third, there is that remarkable instability in the geographical structure of Patagonia which seems to have caused great geographical changes in recent times.

As I heard the paper I could not help being reminded of the passage in Charles Darwin's book on Patagonia, in which he said it seemed as improbable that any country could have kept unchanged in position throughout a whole geological period as that the atmosphere could have kept absolutely calm throughout a whole season. That probably seemed a sensational exaggeration, but when we read the evidence brought forward by Señor Moreno, and the great geographical changes that have so recently occurred, that remark seems justified. I can only hope that the invitation Dr. Moreno has given will be taken up, and several typical areas in

the country deliberately worked out by some expedition, sent out on a scale commensurate with the important work.

Colonel CHURCH: Many explorers have given us scraps of geographical information regarding Patagonia, and sharpened our appetites for more knowledge of that *terra incognita*. Since our childhood, we have allowed our fancy to play with its mysteries, and have longed for some bold explorer to thoroughly penetrate them. The world has scarcely known that, quietly, but intelligently and indefatigably, a great Argentine traveller and *savant* was busily engaged in gathering for us what we so longed to possess; and therefore we give no ordinary welcome this evening to Dr. Moreno, who lays before us the geographical treasures which he has accumulated, the rich fruits of many years of wanderings and careful studies in the interior of that, thanks to him, no longer unknown land.

I have seen much of the coast-line of Patagonia, but have never penetrated its interior. Some of the fjords and islands among which I have voyaged, on its west coast, are marvellously beautiful. In all of the gorges of the low mountains, glaciers pour from beneath them streams of water from such an elevation that they break into mists before striking the ocean, and are spanned by rainbows.

The line of coast from the island of Chiloe to the Straits of Magellan is one of the rainy regions of the world. A great antarctic current strikes Tierra del Fuego on the south side. A fraction of it takes a direction a little to the north of east towards the Cape of Good Hope; but the mass of it finds its way along the west coast of Patagonia, under the name of the Humboldt current, until it is lost in the mighty equatorial stream which moves majestically westward across the Pacific ocean.

On the Atlantic side of Patagonia, we have another equatorial current setting southward, and so heated that, on any parallel of latitude between the mouth of the Plata river and the Straits of Magellan, it is six degrees warmer on the Atlantic side of the continent than it is on the Pacific side, the temperature of the latter being lowered by the antarctic current I have mentioned. In consequence, the colder atmosphere of the Pacific coast rushes eastward through the wide glacier-filled valleys of the low Patagonian Cordillera to fill the vacuum created by the heated belt on the eastern slopes of the mountains, and the result is an abundant rainfall among the eastern foothills of the Andes and that long series of lakes which has been shown to us this evening, thirty to forty in number, nearly all of which lie along or near to the 72nd degree of longitude west from Greenwich. These not only collect the storm-waters, but the flow from the glaciers and the melting snows, and, through deep gorges across the tertiary formation of Patagonia, send their surplus waters to the Atlantic. It is a curious fact that, generally, these gorges in Patagonia, from the Rio Negro to the Straits of Magellan, run nearly east and west. If we start from the *massif* of the Andes in Bolivia and move southward, we find that almost all the inter-Andean depressions run nearly north and south until we reach about lat. 34°, and that these have been so terribly eroded in past geologic ages that the valleys are filled to a great depth with shingle, as, no doubt, Dr. Moreno can confirm. These characteristics continue nearly to the northern frontier of Patagonia; but south of this, the depressions change their course, as I have said, to east and west. This seems to indicate that Patagonia was once a vast archipelago, cut by numerous inter-oceanic straits and fiords, filled with great glaciers, which, as they disappeared, denuded the mountains and formed that vast tertiary Patagonian plain which so attracted the attention of Charles Darwin.

It is notable that the continental *divortia aquarum* are not always found in the Cordillera of the Andes, and this is especially true of Patagonia; for the water divide is frequently far east of the mountains and in the middle of the great

Patagonian plain, from which rivers flow westward through the Andean gorges (the straits of the ancient archipelago ?) into the Pacific ocean.

Similar examples, but perhaps not originating from the same cause, are found along the whole extent of the Andean Cordillera. There is an instance in Bolivia: the La Paz river, which I have descended, rises between the main and coast ranges, cuts through the former, and pours north-east into the Beni valley.

In my travels in Ecuador, I found several rivers which rise on the slopes of the inland mountains, cut through the coast range, and empty into the Pacific ocean. The Pastassa river rises on the inter-Andean plateau, and carves its course through the inland range eastward to the river Amazon. The most notable instance is the Guallabamba river, which rises on the slopes of Cayambi and Cotopaxi, those great volcanic cones of the inland Cordillera overlooking the basin of the Amazon. The Guallabamba has, through a vast deposit of volcanic detritus and ash, scored for itself a profound bed, a mighty gorge which I crossed some years ago with great difficulty, and found by barometric measurement to be 2000 feet deep in a distance of only half a mile. The river has sawed westward through the Pacific coast range around the northern base of the volcano of Pichincha and found its way to the Pacific. When Cotopaxi is in eruption, and its melting snows swell the volume of the river, nothing can withstand the grinding force of the rock-and-mud-laden waters, which, in a tremendous wave, race onward to the ocean.

It is too late to say much this evening; but let me add that I am delighted that Dr. Moreno has made the suggestion to send an expedition to Patagonia to make further explorations. It is a field brimful of interest, and destined to become an important province of that young and vigorous country the Argentine Republic, the progress of which so challenges our admiration. Its enlightened Government might well find it a highly profitable venture to supply the necessary funds, and entrust to our Royal Geographical Society the organization and direction of an expedition to complete the work so admirably commenced by Dr. Moreno.

The PRESIDENT: It is now my great pleasure to invite you to pass a vote of thanks to Don Francisco Moreno for his valuable paper. Speaking for myself, and probably for the rest of the meeting, I can say that I have never before learned so much new geography in so short a time. It is many years since we heard anything of this Eastern Cordillera at one of our meetings. I think it is at least thirty-five years ago since Sir Woodbine Parrish communicated a paper from Don Manuel Cox, and though he described Lake Nahuel-Huapi exceedingly well, we could not then have such an idea of its beauties, as we have received from the magnificent photographs of Don Francisco Moreno. I had also heard of Lake Viedma, otherwise the whole of these lakes are entirely new to me. They appear to have been the ends of fiords, exactly like those on the western coast, but we were until this evening in ignorance of their exact positions. We knew, of course, from the descriptions of Charles Darwin, of that great tertiary plain and of its terraces, for I suppose it is now established that the word Patagonia is the same as the Quichua, *Pata*, "a terrace," and *cerna*, the plural particle, meaning "the land of terraces," exactly as Charles Darwin has described them; but we knew nothing of this marvellous country at the foot of the Cordillera, and for this knowledge we are indebted to our friend, Señor Moreno. I don't doubt that the new tracts he has described will in the future become a very important country, that there will be great cattle farms along the eastern Andes, and that there will be large hotels on the shores of Nahuel-Huapi frequented as health resorts, not only by South Americans, but by Europeans. We have always had most friendly relations with the geographers of Buenos Aires and the whole Argentine Republic, and I trust that that friendly feeling will always continue. Science has to thank Don Francisco

Moreno for the establishment of the museum at La Plata, where geographers are instructed, where information on the geography and geology of the country can always be obtained, and which has been visited by Dr. Lydekker, who I regret is unable to be present this evening through illness, as well as by other Englishmen.

You will therefore, I am sure, feel that we owe a very large debt of gratitude to Don Francisco Moreno for all his labours during many years, and more especially for the delightful evening he has given us, and the beautiful views he has shown us. I now ask you to pass a vote of thanks to Dr. Moreno for his paper.

A TRIP TO THE CHINESE SHAN STATES.*

By FRED. W. CAREY.

Geography of the Route.

From Sumao our route led almost due west. As soon as we left the Sumao plain we commenced to ascend the first of the numerous mountain ranges which run parallel to the Me Kong. But during the whole of our trip we crossed no range of any great height. Nature's best attempts at elevation in the regions south and west of our starting-point never exceeded 7000 feet. Her greatest efforts seem to have been reserved for places further north; for, as the Me Kong grows in size and importance, so the mountain ranges diminish in height, until the extensive low-lying plains of Eastern Burma and French Laos are reached.

On the morning of the third day we arrived at Lung Tang, the capital of Liu Shun, one of the twelve Shan districts known by the name of "Sip Song Panna." These twelve states are subordinate to the principality of Kiang † Hung; but for many years the Prince, or "Sao Beva," of that place has been unable to maintain more than a nominal supremacy. Tribute is still paid by eight of these twelve districts; the amount, however, is ridiculously small, and is dependent almost entirely on the goodwill of the respective chieftains, who are called "T'u Ssŭ."

The "Sip Song Panna" was to have formed part of the "Buffer State"—proposed in 1895, but found impracticable. More than one hundred years ago the "panna" was enumerated as follows:—

1. Meng ‡ Wang.	2. Cheng § Tung.
3. Pu Teng.	4. Wu Tei.
5. Meng Wu.	6. Liu Shun.
7. I Bang.	8. I Wu.
9. Meng La.	10. Meng Lung.
11. Meng Cheh.	12. Meng Ah.

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* Map, p. 472.

† *Kiang*, the Chinese equivalent of the Burm. *Keng*, Siam. *Chieng*.

‡ *Meng*, the Chinese equivalent of Burm. *Mong*, Siam. *Muang*.

§ *Cheng* = Keng.

Though since that time many changes have taken place, eleven of the subordinate states can still be defined with a certain amount of accuracy. The twelfth—Meng Ah—seems to be irretrievably lost to record and recollection.

The first three are situated in the "Hsien," or district, of Ning Erh, which belongs to Pu Erh-fu. Wu Tei and Meng Wu were neglected, or rather never properly occupied, by the Chinese, and recently became French territory. The chief towns, named respectively Muang-U-Nua and Muang-U-Tai, are situated on the Nam U, a river which joins the Me Kong just above Luang Prabang. The remaining seven

VIEW OF THE YUAN CHIANG VALLEY FROM MO-LANG-PO.

districts are in the prefecture of Sumao, and under the direct jurisdiction of the Sumao T'ing.

The history of the "Sip Song Panna" seems to have been a series of disputes about the succession; and desultory fighting for the supremacy was kept up for years, and until quite recently, between rival chieftains. At one time the T'u Ssŭ of Liu Shun, having beaten the Prince of Kiang Hung, was the acknowledged head. But, having aroused the jealousy of other chieftains, he was defeated in battle, and the Kiang Hung Prince again reigned supreme.

Of late years Liu Shun has been under the more direct control of the Chinese. In 1884, some dispute having arisen, sharp fighting took place between the Chinese and the followers of the Liu Shun "T'u Ssŭ." For three weeks the Chinese besieged Tao Kuan-chai, the chieftain's residence,

without any marked success. Then they had resource to strategy. Their commander sent in a flag of truce inviting the "T'u Ssŭ" to a parley and repast. Not suspecting treachery from a man with whom he had formerly been on very friendly terms, the T'u Ssŭ accepted the invitation, and was killed whilst sitting at table. Discouraged by the loss of their chief, the Shans soon afterwards surrendered, and the trouble ceased. Tao Kuan-chai, which lies in the north-western end of the Sumao plain, was laid in ruins, and the "Pai I" retired to Lung Tang. There is still a very fine Burmese temple at Tao Kuan-chai, which, despised by the Chinese and neglected by the Shans, is fast falling into decay.

THE GREAT RAPID, RED RIVER.

I-Wu and I-Bang are too well known as the famous "Tea Districts" to need much description. They are the most Chinese of all the Shan states, there being at both places a fairly big Chinese population engaged in the cultivation of tea. Malaria is so prevalent in five of the ten "panna" which remain to China that the Chinese will not dwell in them. Witness the complete abandonment of the Yu Lo—a town which formerly ranked as an assistant sub-prefecture. For the same reason the Chinese officials can exercise no more than a nominal control over those districts. The actual *military* jurisdiction of the Chinese does not extend more than a few miles to the west or south of Sumao.

Meng La lies to the south of the I-Wu "Panna." In the south-

eastern corner of this district are situated numerous salt wells, capable of producing large quantities of salt, but the inhabitants are too lazy to work them.

Meng Lung lies on the right bank of the Me Kong, below Kiang Hung, and contiguous to the State of Kiang Kheng. The district produces a little cotton, and the chief town is on one of the main caravan routes from Burma.

Meng Cheh is perhaps the most important of the twelve "panna." It lies due west of Kiang Hung, and east of the State of Meng Lem, or Meng Lien. In 1897 the T'u Ssŭ of Meng Cheh rebelled against his

THE RED RIVER AT HSIUKAI.

suzerain—espousing the cause of the prince's younger brother, who had designs on the throne. The prince's forces were worsted in the sanguinary conflicts which followed; but the provincial authorities then ordered the Sumao T'ing to go down and put a stop to the fighting. He visited Meng Hai—a place lying about halfway between the two capital towns—and managed to patch up a peace between the disputants. He was the first Chinese *civil* official to visit the "Sip Song Panna." Many of his soldiers were carried off by malaria *en route*, and the T'ing himself contracted a fever from the effects of which he died shortly after his return to Sumao.

Some writers have included Meng Ah with Meng Cheh. All trace of the Meng Ah mentioned in old histories seems to be lost, though the Chinese are positive that it was situated to the west of the Me Kong.

One important place to the west of that river, Meng Wang, was, years ago, included in the marriage-portion of a Liu Shun T'u Ssŭ's wife. I think it probable that this place formed part of Meng Ah; and the remainder of that legendary "panna" may have been forcibly annexed by the bellicose state of Meng Cheh.

The principality of Kiang Hung lies athwart the Me Kong. It is called by the Chinese Chiu Lung-chiang, or Ch'e Li. The capital town, Chieng—written Xieng in those wonderfully accurate old Jesuit maps—is situated on the right bank of the Mekong, in lat. 21° 58′ N. There dwells the prince, Ham Lü. He has also a residence at Hsiao Meng Yang, a place some 60 li north-east of Chieng. His excellency, Ham Lü, has a rascally reputation, and is constantly at variance with his subordinate Fu Ssŭ.

Each "panna" is subdivided into so many divisions ruled by "Tsung Pia"—who often by courtesy are styled T'u Ssŭ. The Chinese have also given them the military rank of "Pa Tsung," equivalent to our sergeant. The "T'u Ssŭ" of a "panna" holds the hereditary rank of "Chien Tsung"—or Lieutenant—in the Chinese army.

For the rest, the Shans have very much the same system of village government as the Burmese.

Two days after leaving Lung Tang we reached the Me Kong, and the day following, after a long and arduous climb, arrived at Ta Ya-K'u. There we rested two full days, then, having obtained the necessary information and a guide, we decided to push on south to Meng Hai. By making our stages longer than usual, we managed to reach that place in five days from Ta Ya-Ku. Meng Hai is the centre of very extensive tea districts. From there our route led due east to the capital of Kiang Hung-Chieng, a journey which took us two days only. Crossing the Me Kong again, we turned our faces once more in the direction of Sumao, and following the usual caravan route, arrived home seven days later, having rested one day *en route* at Hsiao Meng Yang.

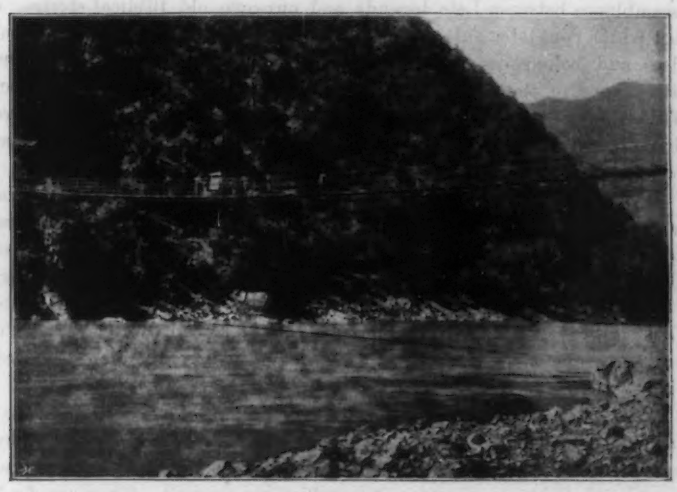
Inhabitants of the Country.

The Shans, who people the greater part of the "Sip Song Panna," are allied more to the Siamese than to the Burmese. They extend over a wide area, and branches of the same family are to be found under various names as far east as Kwang Hsi. The French call them Lü or Tai, and the Chinese "Pai I" or T'u Chia.

The "Pai I" generally build their houses down in the plains near running water. They are very cleanly people; and their houses, made of bamboo, are usually constructed above the ground on roughly hewn poles. Unlike the Chinese, they do not crowd together in large communities, preferring rather to live in many separate villages with an average population of five hundred souls. Kiang Hung itself consists of more than fifteen such villages scattered over a large area.

In fashioning articles from bamboo the Shans are fairly clever; but they can work neither wood, stone, nor metals. The women are pretty and industrious, the men ill-favoured and indolent. Rice grows without trouble in their fertile plains. The cultivation of tea or a little opium pays for their luxuries, as for the silver ornaments which their women like so well. Their ignorance does not seem to weigh upon their consciences, and they have the appearance of living contented and fairly happy lives.

A very large proportion of the aboriginal tribes scattered over Yunnan and Kweichau are of Shan origin. Amongst these may be mentioned the T'u Lao of Mengtse (not to be confounded with the Tu



THE CHANG LO-PING SUSPENSION BRIDGE OVER THE HO-MA RIVER.

La, a Lolo tribe), the Lung-jen of Kai Hua, the Min Chia of Ta-Li, and Chin Tung, and the Sha-jên of the Red River valley.

With the Shans in the "Sip Song Panna" must be classed the "Akka," descendants of a subjugated race who have lost their original language, though they still retain many customs which differ *in toto* from those of their conquerors. They have their habitations up in the mountains, where they cultivate maize, tobacco, and millet. The women are very scantily attired; they wear little beyond a short pleated kilt; but seem to be fond of decking their bodies with silver ornaments. Though the "Akka" have conformed more or less to the habits and customs of the Shans, they certainly belong to a different race, and I hope to learn something of their history before leaving Yunnan.

In places along the route we met people belonging to the race of Lolos; a generic name for many tribes of the same family in Yunnan and Suchuan, whose origin seems to be wrapped in myth and mystery. All the information that we have concerning the ancient history of these people is speculative. At present they are practically "hewers of wood and drawers of water" to the Chinese. They are identical with the "Tsuan-man"—a people occasionally mentioned in old Chinese chronicles of Yunnan—but it is impossible to get any definite idea of their real origin. Some writers have described them as the Black Branch of the Aryan family. Their arguments, however, are far from being conclusive, and there is just as much reason to suppose that they are the descendants of the lost tribes of Israel. Indeed, recent research shows a certain resemblance between Lolo legends and our own old Biblical stories—a fact which could be enlarged upon were there not so many religious ideas and beliefs common to all humanity. Diligent enquirers are discouraged by the vague ideas of the natives themselves on the subject of their ancient history; and as the Lolos are fast losing their distinctive characteristics by intermixture with the Chinese, there is every year less chance of anything certain being discovered.

The Lolos may be divided into two branches—the *Superior* and the *Inferior*. To the former belong the Pu La of Mengtse and A Mi-chu, the Tu La (Kai Hua district), the Ta T'ou of Sumao, and the Lo Hei of Chên Pien. These latter are only met with to the west of the Me Kong. The Pu Tu, Woni, Kato, and Ma Hei belong to the Inferior branch. These tribes, with the exception of the Ma Hei, who dwell around Pu Erh and Sumao, are to be found almost anywhere between the Red River and the Me Kong.

The Lolos live up on the plateau and are very industrious; cultivating rice, tobacco, and opium. In the "Sip Song Panna" they rent their lands from the Shan T'u Ssŭ of the district, but they are also taxed by the Chinese, an imposition which they resent. They are fond of music and dancing—amusements which they frequently indulge in on moonlight nights. To Europeans they have always proved themselves hospitable, but they do not extend the same regard to the Chinese. Neither does this seem remarkable when one remembers that the latter often deprive them of their lands, their property, and their liberty.

The Me Kong.

Our first view of the Me Kong was somewhat disappointing. Shut in by mountain ranges rising away up to 5000 feet on either side, the appearance of the "great artery of the Indo-China" did not equal our expectations. We crossed at the Chiang Pien Ferry. The height of the river there is 2250 feet above the level of the sea. From bank to bank at high water, *i.e.* during the rainy season, it is not more than 200

yards wide. When we crossed (April), the width did not exceed 130 yards. The current is rapid, and the water of considerable depth. The ferry consists of a large but clumsily built boat capable of accommodating eight or nine pack-animals.

Malaria is very prevalent in the valley of the Me Kong, and in the plains to the south-west of Sumao. The Shans suffer from the usual "ills which flesh is heir to," but do not seem to be affected by the fever. I have come to the conclusion that the cause of such great mortality amongst the Chinese who visit those places must be sought for not so much in the water, altitude, heat, or situation of the plains, as in the physical frailties of the men themselves. Brought up generation after

THE SUSPENSION BRIDGE OVER THE PAPIEN RIVER.

generation in the highlands of Yunnan, in a too equable climate, they can bear neither extremes of heat nor cold. Under favourable conditions they can perform feats of endurance impossible to the European; but, once attacked by fever, they succumb very quickly.

We had no sickness amongst our little party during the journey, but on our return to Sumao, two men were seriously ill for some time. Along the route we met many parties of tea and cotton porters coming up from the lowlands. These men live very hard lives, carrying heavy burdens all day, and sleeping at night in the open on the damp ground. We passed many hastily made graves, and once we saw two men lying by the roadside stricken with malaria. They had been deserted by their comrades, and were waiting for the end. Death comes to them,

so the Chinese say, in the shape of a beautiful young girl—a poetical fancy which has its origin probably in the wild babblings of dying men.

We crossed the Me Kong again at Kiang Hung. There the elevation of the river is 2100 feet—150 feet lower than at Chiang Pien. The river, running through a big plain, had widened considerably. The ferry was composed of two long narrow boats lashed together, and with a bamboo platform on top. There were a few small fishing-boats working up the shallows near the banks; but we saw nothing in the shape of any vessel capable of really navigating the swift waters of the river.

Occasionally one hears rumours of attempts to navigate the Me Kong

MANHAO.

further south, and a small French gunboat is to try and reach Kiang Hung this summer (1898), when the river is in flood. But, though such undertakings are laudable enough in the interests of science or geography, they will never be able to prove that the Upper Me Kong is navigable from a commercial point of view.

Ta Ya-Ku.

One of the reasons which led up to this trip was a desire to find out the actual position and status of Ta Ya-Ku, a place of whose importance as a trading centre we had heard much. It is a small commercial entrepôt situated 5200 feet above the sea, and 60 li (20 miles)

from the right bank of the Me Kong. Most of the residents are either petty Chinese traders, or agents for Sumao tea and cotton merchants.

Ta Ya-Ku is made up of three villages—Yu Tang, Ying Pang, and the Kai-shang, or market. The population of the latter place is about five hundred. Shortly before my arrival it had been almost entirely destroyed by fire. The buildings are of the usual wooden-framed, mud-wall, and straw-thatched kind, seen everywhere in Yunnan, and fires occur periodically every five years or so, being sometimes attended with loss of life. There are only two brick-tiled houses in the place; but in this respect it is better off than Chen Pien, the capital of the prefecture, which does not possess a single one. Chen Pien is only

SUMAO FROM THE WEST.

three short stages from Ta Ya-Ku, but is a less important and smaller place.

A market is held every sixth day at Ta Ya-Ku, it being difficult at other times to buy even the ordinary necessities of life. Cotton, tea, and opium are brought in from the Chen Pien and Meng Lien (Meng Lem) districts (and some from beyond the frontier) to exchange for salt, native cloth, iron pans, and ironware, imported from Sumao. Money is little used in commercial transactions in the Shan states, there being instead a complicated system of barter. Cotton is usually exchanged for its weight in salt—a transaction particularly advantageous to the Chinese merchant. Every picul of cotton laid down at Sumao

is a source of profit to him of about 5 taels. In the rainy season, however, the owner of the cotton does not part with his goods so cheaply. He then requires a little silver in addition to the salt.

Most of the tea and cotton is sent to Sumao, the remainder going by various routes to Tali, Mien Ming, or Shunning-fu.

On market days the smaller tradesmen lay out in the street their stock of matches, empty bottles (a much-prized article in Yunnan), tobacco, flints and steel, etc., and bargain for opium with the native visitors in regular Cheap-Jack style. Amongst the frequenters of the market I noticed some K'a Wa, members of a particularly savage and ferocious tribe who inhabit the Chen Pien and Shunning districts. They are said, by the Chinese, to worship the heads of tigers and men recently killed. But, as the Chinese are quick to invent equally remarkable tales about any alien race, such statements should be accepted with caution.

Trade and Trade Routes.

Tea is the principal product of the Chinese Shan states. The best known districts are I-Wu and I-Bang. Chinese — mostly Shihping people—have settled in considerable numbers at both those places, and themselves superintend the cultivation of the shrub. But the largest, and therefore the most important tea-hills, lie to the *west* of the Me Kong. They produce every year more than three times the total output of I-Wu and I-Bang combined; but, the districts being too unhealthy for the Chinese, the cultivation is entirely in the hands of the "Pai I," and the tea, lacking the Chinese treatment, is of inferior quality. Meng Hai is the chief market, and the price there varies from 4.50 taels to 8.00 taels per picul.

There are no reliable statistics of the tea trade, but it is estimated that the districts of I-Wu and I-Bang yield about 10,000 piculs, and the Meng Hai districts 30,000 piculs, yearly; a total of 40,000 piculs. About one-third of this quantity comes to Sumao, where it is sorted, pressed into cakes, and packed for exportation to all parts of China. A little tea is also grown in the Chen Pien prefecture, near Meng Mang.

The best quality, including the "tribute tea," arrives at Sumao between the third and sixth moons. That destined for Imperial consumption is then specially packed and forwarded to Peking. Before reaching its destination, it has to pass through so many official hands that the quantity is very greatly diminished. A small quantity of a peculiar extract of tea, resembling brown sugar, is also made here and sent to Peking. During the four months mentioned no merchant is allowed to purchase that quality from which the "tribute tea" is chosen, and the likin on *all* tea arriving at Sumao is doubled.

The merchants here sort the greater part of the tea into three kinds. The first is pressed into circular cakes, and goes to the capital of the

province, Yunnanfu, where it is often sold for as much as 40 taels per picul. The second is also made up into cakes, and is the ordinary "Pu Erh" tea of commerce. One meets with this kind everywhere from Bhamo to Shanghai. The third quality, consisting of stalks and refuse tea, is sold to the Yunnanese Thibetans, who come down to Sumao from A Teng-tse and Li Chiang-fu between the tenth and second months of the Chinese year. There are other qualities of tea of an uncommercial kind, varying in value from 10 taels to 120 taels per picul.

During our trip the route led for several days through the Meng Hai and Meng Lung tea districts. The average height of the hills was 4000 feet above sea-level. The tea is grown under the shade of big

TEMPLE NEAR SUMAO, CONTAINING LARGE GILT BURMESE GOD.

trees. The appearance of some of the tea-shrubs indicated great age. Their height is usually over 6 feet, and those we saw were very roughly pruned.

Hundreds of "Pai I" (Shan) women and girls were busy picking the leaves, which they put into cotton bags slung around their necks. They worked in a good-natured way, and greeted our little caravan with jests which were scarcely polite. The Shan women are, to say the least, extremely unconventional. Their most conspicuous article of dress is a long skirt, with multi-coloured borders, reaching to their ankles. On special occasions they wear a pretty kind of bodice, but they evidently did not think it worth while to treat my appearance as a "special occasion."

When a sufficient quantity has been picked, the tea-leaves are turned out on bamboo matting and "bruised," the girls kneading them with their hands, as if working dough. They are then spread out in the sun to dry. During the drying process, the tea has to be turned over and occasionally shaken. This is done mostly by children and chickens. It is then ready for sale, and is weighed and packed under the purchaser's supervision.

A great many tea caravans leave Meng Hai for Tali and other northern markets direct. They cross the Me Kong at the Chen Kung ferry, keep up the Man Pan valley, and pass through Wei Yuan and Chin Tung. Traders going down to Kiang Tung (Meng Keng) also purchase small quantities on the spot; in fact, tea from Meng Hai finds its way in every direction.

Cotton, which forms our principal import, comes from the immense plains lying either side of the Me Kong, south of the Chinese frontier; from Kiang Kheng, and Kiang Tung. Cotton caravans on their way to Sumao cross the Me Kong at Kalampa, or Chen Kung. Many small routes converge at Ta Meng Lung. About 16,000 piculs of cotton enter Yunnan yearly through Sumao.

Opium is grown in small quantities in all parts of the Shan states. It is bought in exchange for cloth, silver ornaments, silk thread, etc., by Chinese peddlers, who bring it to Sumao for sale. It is of slightly superior quality to the ordinary Yunnan opium, and the supply is amply sufficient for local consumption. Around Sumao, the soil being unfavourable, not much opium is grown. The annual production of Yunnan amounts to about 45,000 piculs. Opium smoking is very general throughout the province, it being the exception to find a man not addicted to the habit. The Shans usually eat the drug, but they have lately taken to smoking it.

Miscellaneous Notes.

A little trade passes through Meng Sing, but the Muong Hu districts are very unproductive. There is a route to Luang Prabang which is little used, there being practically no trade in the whole of that region. Trade, *viâ* Meng Lieh, is also of a very unimportant nature, and rumours of a brisk caravan business with Talang have no real foundation.

There is scarcely any demand for foreign goods at Sumao. Japanese matches and Cantonese tobacco are reported here from Mengtse. Enough cotton cloth is made here to satisfy local needs. The Shans also manufacture a coarse but strong kind of cotton cloth for sale to the Chinese.

In November of each year a few Mahommedan traders from Yunnan, Tali, and Hsin-hsing, pass through Sumao on their way to Mandalay, Rangoon, Chieng Mai (or Zimme or Siam) and Mulmein. They return regularly during the month of June, bringing with them small

quantities of grey shirtings and woollen goods. But, even if there were a demand for foreign goods, the cost of transport is prohibitive—all merchandise being carried by pack-animals throughout Yunnan and the Shan states. These Mahommedans confine their business operations to Burma, the money which they make there being brought back in the shape of rupees. Rupees are in great demand in Yunnan-fu—a demand which arises out of the silver question and the vagaries of exchange—and which, therefore, cannot be discussed in this memorandum.

The merchants of Sumao have no agencies in Burma, and their dealings are in consequence confined to frontier produce, *i.e.* tea and cotton. Under existing conditions it is impossible to anticipate the rise

TIBETANS IN MARKET AT SUMAO.

at Sumao of a foreign trade sufficient to satisfy the local requirements of the surrounding districts of south Yunnan. As regards the dream that Sumao might become a great distributing centre for the whole province, its realization seems impracticable.

Mengtse—owing to its proximity to the tin mines of Kuo Chiu—the acknowledged superiority of the Tongking (Red river) route, and the presence of enterprising Cantonese merchants, *is* such a centre.

Teng Yueh, with its close commercial connection with Bhamo, once opened, and the transit pass system with its advantages put into force, may become such a centre.

But Sumao possesses none of these advantages. It is far from any

trading centre in Burma or Tongking, and there is not a single Cantonese "Hong" resident here. In fact, it seems destined to remain the centre of a small circle of frontier trade.

There is no product of the Shan states or of southern Yunnan which holds out any promise of ever becoming an important article of export. The samples of "Pu Erh" tea which have from time to time been sent to various foreign markets, have not been favourably received by the public. Unless some æsthetic wave alters the present prevailing taste, there can be no demand in the future for what might be a fairly important export. And, in any case, cost of transport would effectually prevent it from competing with Assam, Ceylon, or other commercial teas.

SOUTH GATE STREET, PRINCIPAL BUSINESS THOROUGHFARE OF SUMAO.

Of the other two important products of Yunnan—tin and opium, the first is entirely a Mengtse export, and the latter is, of course, for internal consumption, though a considerable quantity is also exported *viâ* Mengtse to Tongking. The remaining exports—furs, medicines, white wax, wool and copper, are products more of the western and northern parts of the province. Most of these find their way to Shanghai *viâ* the Yangtse, and a part may eventually seek the Teng Yueh route; but possible goods for carriage by projected Yunnan-Burma railways are difficult to think of. Indeed, any one who has travelled in Yunnan, and has seen the general poverty of the inhabitants, and the extremely mountainous nature of the country, scarce believes that such an enterprise as a Burma-Yunnan-Suchuan railway is contemplated seriously.

The only practical line (I speak from a financial and commercial—not from an *engineering*—point of view) would be one from Laokai, on the Red River, to Yunnan-fu *viâ* Mengtse. Such a line is already contemplated, and the route has been surveyed by French engineers. But, except the short one from Lang-thuong to Lang-Son, there are as yet no railways in Tongking itself, and it would be safest, therefore, to leave the hope of ever seeing such a line completed as a legacy to our children's children.

I only wish to point out here that the talk of the necessity of railways for "tapping the prodigious resources of Yunnan" is all nonsense. The majority of persons who hold these ideas are either blinded by a genuine desire to see British trade benefited, or led astray by the statements of (1) those who would benefit by the *construction* of such railways, (2) those who, on the strength of a visit to Shanghai, like to be regarded as authorities on all questions concerning the Far East. To those who cannot study this question on the spot I recommend the perusal of Baber's notes, and Bourne's official report. They will then know what is the commercial worth of "map railways."

At two of the most effective points on the Me Kong—the Chen Kung and Chiang Pien ferries—there are stations for collecting a Prefectural tax. Though the receipts at both these places should be considerable, the figures as repeated to the head office at Sumao are insignificant. The climate is so unfavourable to Chinese that the staff is always quite inadequate to enforce the tax, and the collectors are obliged to accept what the tea and cotton traders are willing to pay.

There are Likin stations at I-Bang, Man Nai, and Meng Lieh only. No difficulty seems to be experienced by the collectors in those places, and the posts are sufficiently coveted to give one the idea that the emoluments are by no means small. Likin is collected on all tea and opium.

The Chinese foreign customs has branch stations at Meng Lieh and I-Wu, but they are failures from a revenue-collecting point of view. The collection of the head-office at Sumao is not enough to pay the working expenses of the customs there.

Conclusion.

Robbery with violence is as rife now in the Shan states as it formerly was in Burma before that country became British territory. That the benefits of British rule are actual and lasting is testified by all traders coming from Kiang Tung to Sumao. But they complain bitterly of the precautions which they are obliged to take to prevent their goods or cattle from being stolen when once they have crossed the frontier. The worst offenders are not the Shans, but Chinese—recognized robbers, who have their homes and families at Sumao and Pu-Erh, and are comparatively well-to-do. No official yet has had the temerity to interfere

with these questionable residents, though a small military mandarin is occasionally detached on a wild-goose chase after thieves who have raided some neighbouring village.

A small but well-organized police force could sweep these ruffians, who do a great deal of harm to trade, out of existence in a very short time; but it is hopeless to expect any such measures being employed by Chinese officials.

Were it not for the situation of the I-Wu and I-Bang tea-districts, the Chinese would look with equanimity on the absorption of the Shan states by foreign powers. The officials recognize that with the means at their disposal they cannot put down brigandage, and that climatic conditions prevent them from exercising proper control over the people of the Shan states. As a solution of their difficulties, they look forward to the time when the old northern boundary of the "Sip Song Panna" shall form the south-western frontier of the province of Yunnan.

SUBMARINE GULLIES, RIVER OUTLETS, AND FRESH-WATER ESCAPES BENEATH THE SEA-LEVEL.*

By HENRY BENEST, Assoc. M. Inst. C.E.

It is the object of this paper to direct attention to the existence, below sea-level, of phenomena of which comparatively little is yet known, but which must exercise a marked influence in altering the conditions of the sea-bottom on many continental slopes.

The frequent occurrence of cable fractures in submarine telegraph lines suggests various theories to account for these unwelcome interruptions. Unmistakable evidence, afforded in some cable repairs of recent years, has disclosed novel causes of rupture, and has extended our knowledge of the hidden dangers that beset the telegraph wire after it has been consigned to its oozy bed. 'Tis an ill wind that blows no good at all. These accidents to cables have already been valuable to science and sub-oceanic research, in directing the attention of geographers to hitherto unsuspected forces constantly in action and altering the features of the sea-bottom.

At localities far apart on the Earth's surface, men, engaged in the fascinating work of seeking, fishing up from the depths of the sea, and joining together again these nerves of the sentient world, come across identical tokens of powerful forces which are silently undoing in quick and merciless fashion that which human skill, ingenuity, and perseverance has been at so much pains to accomplish. However carefully planned and carried out a survey may have been, prior to laying a system of ocean cables, breaks have occurred, sometimes within a few months of their laying, and, what is most remarkable, at depths that have been looked upon as safe—the character of the bottom, as disclosed by the sounding-tube, being of that oozy nature so favourable to the longevity of a cable.

Such were the circumstances attending the fracture of the South American

* Charts, see p. 472.

Company's cable off Cape Verde three months after its laying, at a depth of 1220 fathoms, on an ooze bottom; and again in 1895, two years and two months later and within 20 miles of the first break, the depth being on this occasion 1574 fathoms. The writer was entrusted with the work of re-establishing communication through this cable on each occasion, and, having been closely connected with the manufacture at Silvertown, and the subsequent laying of the cable between Brazil and the African coast, he naturally took a greater interest than is usual in the ordinary run of repairs to cables which have broken down through age and ordinary wear and tear. That which is here narrated is partly from the writer's own personal observation, and partly from the observations of other officials of the India Rubber Company, these experiences being supplemented by references to valuable contributions from officials of other cable companies.

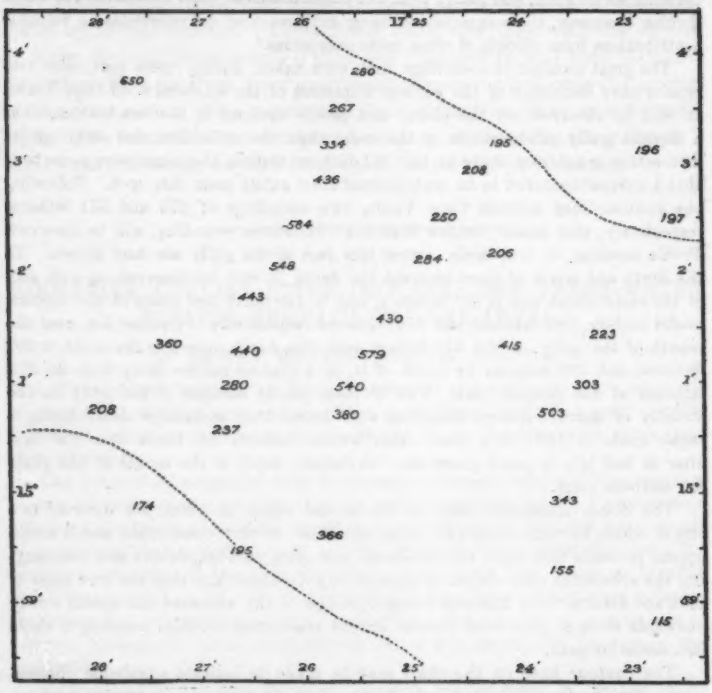
The great number of soundings that were taken during these particular two repairs gave indication of the curious formation of the sea-bottom off Cape Verde. It will be observed, by the chart, and profile sections of the sea-bottom, that a distinct gully exists nearer to the coast than the cable line, and although its delineation is not very sharp at the 761-fathom station, the conclusion come to is that a submarine outlet to an underground river exists near this spot. Following the contour-lines towards Cape Verde, two soundings of 675 and 531 fathoms respectively, still nearer inshore than the 761-fathom sounding, will be observed. Profile sections, to true scale, across this part of the gully are here shown. To the north and south of these sections, the depth, it will be observed, on each side of the easternmost one is 195 fathoms, and to the north and south of the western profile section, 280 fathoms and 174 fathoms respectively. Farther out, near the mouth of the gully, at the 675-fathom spot, the depth shown to the south is 202 fathoms, and 392 fathoms lie north of it, on a gradual incline rising from the 675 fathoms at the deepest part. Two of these profile sections of the gully in the vicinity of the 675-fathom sounding were drawn from soundings taken during a repair made in 1897 to a coast cable which connects St. Louis and Yof bay, after it had lain in peace across the 761-fathom depth at the mouth of the gully for thirteen years.

The South American cable, at the second repair in 1895, was diverted to a course which brought it parallel with, and close to this coast cable, and it would appear probable that those two cables are now lying on a ledge above and overhanging the submarine river outlet we suppose to exist there, and that the vast mass of mud and detritus from this source may now flow to the westward and spread slowly outwards along a time-worn furrow on the sea-bottom without meeting a cable laid across its path.

The contour lines on the chart may be taken to indicate a probable channel way, or submarine ditch, that may be imagined at some remote period to have been grooved out by the constant action of water making its way to the sea through a surface river outlet, in connection with, or having its course through, localities on the mainland where the lagoons are now situated, and which, in turn, may have been connected with a great inland river. The Admiralty charts, and those of the French Depôt Général de la Marine, give indications in support of such a supposition.

A river, the higher reaches of which are crossed by the railway between St. Louis and Dakar, now discharges, in the wet season, into these lagoons, but in the dry season the water disappears in the sandy bed before reaching the neighbourhood of the coast. Water is always present, the river exists behind these lagoons, which are in a direct line between that river and the head of the gully. These facts are significant of a former surface outlet, and a submarine connection between river, lagoons, and the sea at the present time.

There are other localities in the world where the physical features on the sea-bottom indicate that at a former period rivers have discharged into the sea, their ancient course now being indicated by submarine gullies. Owing to slow but stupendous changes during the lapse of ages, such rivers have been, doubtless, diverted to subterranean courses, and, their waters escaping beneath the sea at a distance away from their former outlets, now cause disturbance on the ocean floor at greater depths; this effect being brought about largely by the silting up of the old channels near to, and extending over, the coast platform of the "continental shelf" within the 100-fathom line.

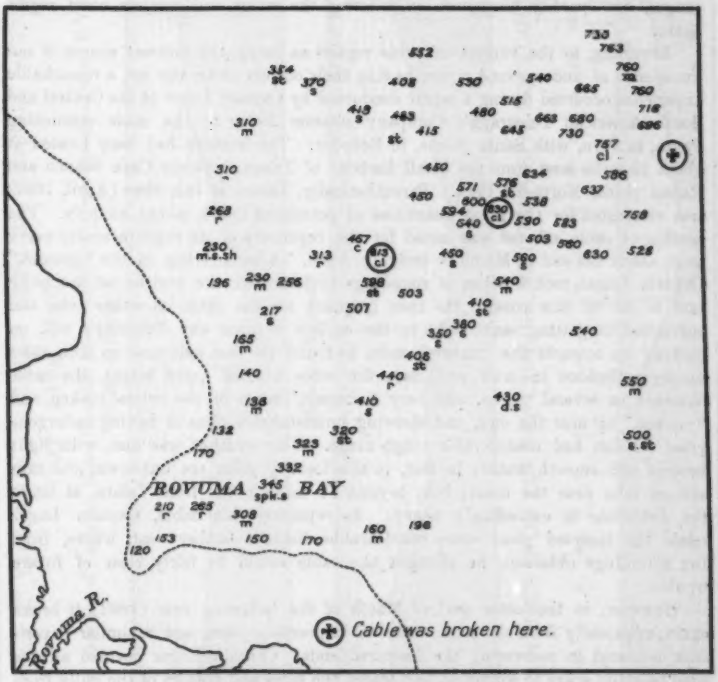


LINES OF SOUNDINGS ACROSS GULLY 14 AND 15 N.M. FROM CAPE VERDE, CORRESPONDING WITH TWO OF ACCOMPANYING SECTIONS.

A very remarkable phenomenon, strongly favouring the theory that a submarine river outfall now exists near to Cape Verde, was witnessed during the afternoon of April 23, 1895, in lat. 15° N., long. 17° 31′ W., 13 miles from shore. While engaged in grappling, the ship was gradually surrounded by great quantities of vegetable growth, having the appearance of river weed. There were also birds' feathers, pieces of orange-peel, whole and broken gourds, scraps of carpet, pieces of driftwood, small branches, etc., and the colour of the sea had changed to dirty brownish green. On the following morning all this had disappeared, and the sea had regained its usual tint of a pale green. The nearest surface river outlet is that of the Senegal, 75 miles distant in a north-easterly direction, and it would appear most

unlikely that such flotsam as pieces of carpet could have been carried by the coast current, which sets to the south-south-west, to so great a distance. No recurrence of this phenomenon took place during the four weeks that were spent in carrying out cable-work in the neighbourhood, nor had such a thing been noticed before, so far as records go.

If the coast current had brought these masses of weed and refuse of human habitation out of the Senegal river, it would have been a more or less constant and familiar appearance, as would also the colour of the water; but the discoloration of the sea-surface with the accompaniment above described was local, and would



ROVUMA BAY, EAST COAST OF AFRICA.

appear to be due to a sudden outburst of river-water in the vicinity and below sea-level.

While upon the subject of submarine gullies, and of the probability of their formation by river outlets, whether at or below sea-level, it may be mentioned that many subterranean rivers are supposed, with good reason, to exist. These have their outlets in some cases in the form of artesian wells.

Off Pescadores point, on the coast of Peru, and off the Rovuma river, on the East Coast of Africa, two localities widely separated, similar conditions have been met with in repairs to telegraph cables. At the latter place much trouble had been experienced with the cable between Mozambique and Zanzibar, and the

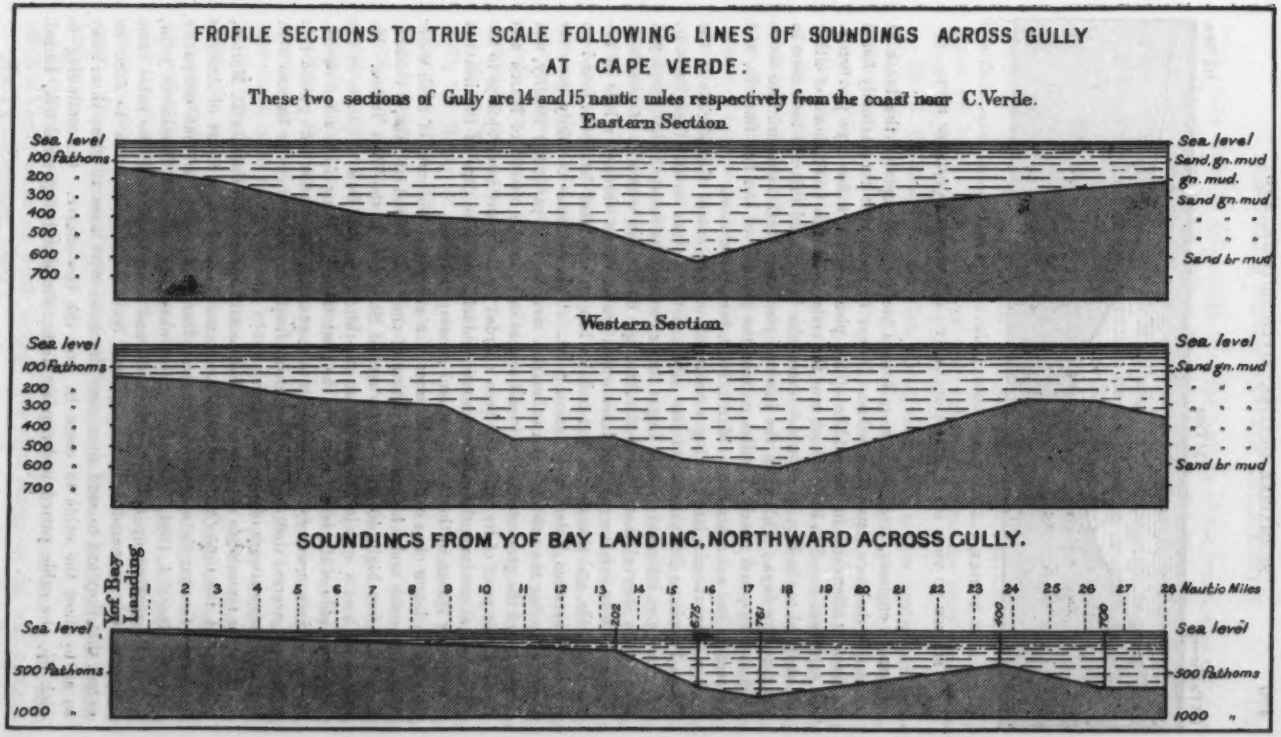
conclusion arrived at was that the cause originated in fresh water making its way to the surface from the sea-bottom, disturbing the ground and fracturing the cable.

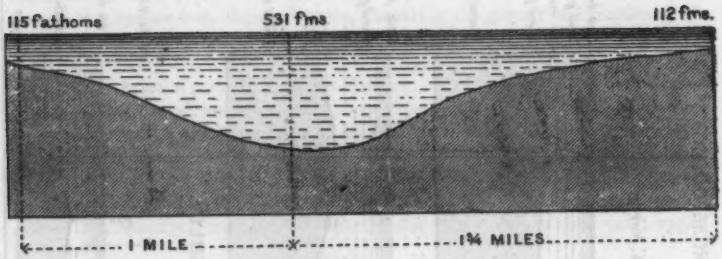
A very remarkable instance of a river having its course underground exists to the north of Arica, a port on the coast of Peru. The bottom of the river valley consists of loose sand, no evidence of water being apparent. At a depth of some 15 feet, however, a firmer stratum of sand is found, and a continuous current of fresh water is distinctly observed as the water rapidly filters through the sand into and out of the pit. This subterranean stream is met with as a rapidly flowing river some distance inland and among the higher foothills of the great mountain ranges, but speedily disappears on entering the sandy and rainless coast region again.

Reverting to the subject of cable repairs as being the indirect source of our knowledge of underground rivers having their outlets under the sea, a remarkable experience occurred during a repair conducted by Captain Lugar of the Central and South American Telegraph's Company steamer *Relay* to the cable connecting Payta, in Peru, with Santa Elena, in Ecuador. The fracture had been located at about 10 miles west from the small harbour of Talara, between Cape Blanco and Parina point, Northern Peru. Parenthetically, Talara at this time (April, 1891) was celebrated for the great quantities of petroleum found in the vicinity. The section of cable affected was noted for the regularity of its rupture nearly every year, about the end of March or early in April. After arriving on the "ground," Captain Lugar took a series of soundings to determine the position of the gully said to lie off this coast. He then grappled for the cable on either side, and succeeded in getting each bight to the surface without any difficulty; but, on picking up towards the fractured ends, he found the last half-knot on both sides deeply embedded in mud and clay, the wires scoured quite bright, the cable flattened in several places, and very "screwy," some of the wires broken and "rucked" up near the end, and showing unmistakable signs of having undergone great tension and considerable rough usage. The weather was fine, with light breezes and smooth water; in fact, in this locality gales are unknown, and rain seldom falls near the coast; but, beyond 50 miles inland from Talara, at times the downpour is exceedingly heavy. In repairing this cable, Captain Lugar relaid the inserted piece some considerable distance farther west, where, from the soundings obtained, he thought the cable would be fairly clear of future trouble.

However, in the latter part of March of the following year (1892), it broke again, apparently from the same cause as in previous years, and a similar experience occurred in recovering the fractured ends. Captain Lugar devoted all the time he could spare to sounding, and traced the sides and bottom of the gully from about half a mile off the entrance of Talara harbour to about 12 miles west. It was noticed in nearly every case, that the specimen of bottom brought up from the deep part of the gully was coarse grey sand and small stones; that of the sides, a very tenacious clay; and from the comparatively level part farther away, soft green mud. The piece of cable inserted this time was laid about 3 miles to the west, in over 1000 fathoms' depth of water, with an abundance of slack, and every confidence was felt that there would be freedom from trouble in this locality for a year or two at least.

The cable ship returned to Callao on the evening of April 1, and, before coming to anchor, the captain received a message from shore, to say that the section they had just repaired was getting weak, and by the time Captain Lugar arrived at the Callao office, communication had been completely interrupted. Mr. Kingsford, the


PROFILE SECTIONS TO TRUE SCALE FOLLOWING LINES OF SOUNDINGS ACROSS GULLY
AT CAPE VERDE.
These two sections of Gully are 14 and 15 nautic miles respectively from the coast near C. Verde.
Eastern Section
Sea level
100 Fathoms
200
300
400
500
600
700
Sea level
Sand, gn. mud
gn. mud.
Sand gn. mud
Sand br mud
Western Section
Sea level
100 Fathoms
200
300
400
500
600
700
Sea level
Sand gn. mud
Sand br mud
SOUNDINGS FROM YOF BAY LANDING, NORTHWARD ACROSS GULLY.
Yof Bay Landing
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 Nautic Miles
Sea level
500 Fathoms
1000
Sea level
500 Fathoms
1000



SECTION TO TRUE SCALE ACROSS GULLY AT CAPE VERDE, NARROWEST PART.

company's engineer, took some tests from Chorillos, and reported the break at practically the same distance as before. It was believed that they actually found the fracture afterwards in the middle of the piece inserted a few days previously. The cable was found to be flattened near the ends, and about 400 fathoms of either side stripped to the bare wires, which were quite bright, and this had been done in less than five days. This time the inserted piece was carried seaward into about 1400 fathoms, and nearly 7 miles outside the position of the last fracture, and the section had not again, up to March, 1892, been interrupted.

Some few months later, during a conversation with one of the officials of the Talara Petroleum Company about the nature of the bottom outside their harbour, this gentleman informed Captain Lugar that a Peruvian half-caste he had employed at the wells asserted that beyond the Amatape mountains, which lie at the back of Talara, there exists a chain of lakes which has an outlet through a hole in the mountain-side, and that canoes and paddles lost on the lakes had been found on the coast between Talara and Parina point. This evidence certainly goes far towards proving the existence of a submarine river in this particular locality, and the period of the greatest outflow would appear to be in the months of March and April. Fair proof of its action has been afforded by the many interruptions to the cable laid across its outlet. These months coincide with the time of the heaviest of the rainy season in the Cordilleras and Amatape ranges.

Captain Lugar cites one other instance of a submarine outburst of fresh water which had come under his personal notice off the Dutch island of Saba, a volcanic cone 1500 feet high, 40 miles north-west of St. Kitts, in the West Indies. He visited by boat a spot in the sea about one-third of a mile from the shore on the south-west side of the island, and saw the fresh water bubbling up in small circles. He sampled some, and found it brackish to the taste. The native who guided him to the spot averred that sloops and schooners frequently filled up their barecas from this submarine stream of artesian water.

Another remarkable experience has been communicated by Captain D. Morton, who was at the time (March, 1884) in command of the West Coast of America Telegraph Company's steamer *Retriever*. During a repair to that company's cable on March 4, 1884, in 650 fathoms of water, 11 miles off Pescadores point, and while picking up towards the break, and when close to it, the cable came up completely surrounded with twigs and branches of olive trees to such an extent that they had to send men over the bows with axes to clear them away so as to allow the cable to come in over the bow-sheave. On continuing to pick up, the cable parted under great strain, the end being, no doubt, buried.

The Ocoña river, 13 miles north from the position of the break, does not flow into the sea, but into a basin or lagoon a quarter of a mile from the sea, and during heavy rainstorms in the mountains this river is transformed into a torrent carrying everything with it. Rapidly pouring into the basin or lagoon, it raises the water-surface above the sea-level, and no doubt, when a certain pressure is relieved by the water in the basin or lagoon again reaching the sea-level, a subsidence of the sea-bottom takes place, carrying the bight of the cable with it, and eventually breaking it with the downward weight and pressure. The nearest river outlet flowing into the sea is the Quilca river, 50 miles east-south-east from Pescadores point. The currents on this part of the coast are variable, and, influenced by the wind, sometimes attain a rate of from 1 to 1½ knots per hour. This cable was again interrupted near the same position on March 23, just twenty days after the previous repair.

Mr. E. W. Parsoné relates that, during some cable repairs carried out under his direction in the same region, soundings in the neighbourhood of Pescadores point, about 60 miles off Mollendo, gave very irregular depth, indicating a channel some 40 miles distant from the coast, and somewhat similar to the Bottomless Pit on the West Coast of Africa. On shore there are signs of an old river-bed, and there are lagoons in the interior. The cable at this spot was repaired many times, and abundance of slack given for all irregularities of the bottom, but still it broke; it was frequently found buried, and was got up with difficulty, bringing up with it masses of branches and trunks of trees, which had to be cut away with axes before the cable could be got inboard. These branches and boles were the remains of olive trees, which do not grow along the coast; they doubtless came from the Arequipa district, some 80 miles inland, where olive groves abound. It would appear that these remnants of vegetation had drifted with the surface river water from the interior, and had disappeared with it underground to emerge at sea by a submarine exit. To support this idea, the breaks in the cable generally occurred after freshets due to rain in the interior. The cable was eventually diverted towards the shore, and no further trouble has been experienced, which would seem to prove that the cable had been laid shoreward inside and above the submarine river outlet.

Mr. R. K. Gray has contributed some very interesting matter in connection with the theory of submarine river outlets being the cause of ruptures in telegraph cables. Mr. Gray's experience on the West Coast of Africa has been that interruptions have generally occurred about the month of March, and the opinions he has formed show very clearly several important points and identical proofs in support of the theory of submarine river outlets. For example, the latitude of the Arica river, the Congo river, and the Rovuma river are practically the same; they are situate between the tropics of Capricorn and Cancer. Well-known authorities agree that in the tropics the month of March is a rainy month, therefore it is fair to assume that heavy falls of rain take place about this period in the unknown interior of Africa and America; while on the shore-lines near where the cables have been broken, there is nothing but sand for miles around, and comparatively little rain. The rains from the interior find their way to the sea by surface rivers in some cases, and by subterranean rivers, in all probability, in others, their subterranean flow being not merely percolation through porous strata, but large volumes of water flowing through caverns and crevices in the Earth's crust. These volumes of water have their source in the mountains, and find their outlets at sea.

There are also some points connected with the depth contour-lines on the map off Cape Verde, which are worth noting. The river shown on the map of Cape

Verde point is probably a small stream fed locally, but the lagoons are created by springs from artesian water. Then, carrying the eye from these lagoons to the sounding of 230 fathoms, a crust of water-covered shore sand will have been traversed, and seaward of the 230-fathoms spot there is the head of a large gully. That gully, by the formation in its neighbourhood, could never have been formed by a surface river, because one finds 230 fathoms increasing almost precipitously to 670 and 700 fathoms. Mr. Gray believes that at about 600 fathoms from the surface, and at about 60 to 70 from the bottom, the outlet of the river will be found, and that at certain seasons, in the month of March probably, a geyser-like effect is produced.

In the last repair to the South American cable referred to at the commencement of this paper, the cable was relaid inshore, and at a higher level than the supposed outlet. On other similar occasions a like course had been adopted, notably off the Rovuma river, in the cable between Zanzibar and Mozambique. The last mentioned of these two cables broke down eight years in succession. Since it has been relaid inshore, some twelve years ago, it has never broken down, and this is doubtless due to the cable being laid shoreward of the submarine river outlet, which probably still continues to periodically throw out its *débris*. In another instance, that of the Sao Thomé-Loanda cable, after this cable had broken down twice in fifteen months, it was relaid nearer the shore, and it then lasted for five or six years.

During the month of October, 1878, the West Coast of America Telegraph Company's steamer *Retriever*, then newly out from England, under the command of the writer, repaired the section of cable between Valparaiso and La Serena, which had been interrupted since July in the preceding year. Upon referring to an abstract of the log kept at the time, it appears that on the 28th of that month the cable was grappled and brought up from a depth of 864 fathoms to the north of the break, Limari gully bearing east 8 miles distant, and that masses of water-logged branches, and roots of bushes and trees, were entangled with the cable near the end, which was much frayed out. The cable to the south of the break was raised on the 30th, the end being broken short, which would go to show that this part had been covered by detritus, thus preserving the cable intact.

On this occasion the new cable inserted was laid in deeper water to seaward, but the section, as stated by Prof. John Milne, F.R.S., in his paper on "Sub-oceanic Changes" (see the *Geographical Journal*, August, 1897), was again interrupted in August, 1880, by an earthquake, and again by a landslip in July, 1885, this landslip being presumably due to an earthquake. On the last repair in 1885, the cable was, so the writer is informed, relaid much nearer in towards the shore, and it has not broken since. The first break occurred about a year after the cable was first laid; the second, about a year and ten months after the first repair; the third, nearly five years after the second repair. Since the third repair the cable has now withstood nearly fourteen years, which fact goes a good way to support the theory that the cable had been relaid inshore of and at a less depth than the submarine outlet of the Limari river, the surface outlet of which is practically a dry bed.

The writer was told, after the repair in 1878, by people long resident at Tongoy, and well acquainted with the Limari valley, that, during floods inland in the winter season, this river rose and inundated its banks for many miles, carrying away cattle and buildings, shrubs and trees, but none of these could possibly have escaped to sea through its surface outlet.

With reference to the Chorillos-Mollendo section of the same company's system, the writer is informed by the secretary, Mr. F. L. Robinson, that this cable was

diverted inshore off Pescadores point in April, 1891, and that they have had no interruption since the deviation. It is satisfactory to see that Prof. Milne ascribes these interruptions to periodical submarine convulsions at great and unequal depths, where the channel of an extinct or subterranean river exists at 40 or 50 knots from the coast, or, "in any case, that all difficulty has ceased since the cable has been diverted to close inshore."

The Central and South American Company's officials off Point Esmeralda, in Ecuador, had a similar experience, and surmounted the difficulty by laying the cable above the supposed submarine river outlet. From all this evidence, it may be considered that the rainy season in the interiors of continents, and the existence of subterranean rivers, account for many interruptions to cables laid near to, or parallel with, coast-lines.

The writer has been favoured by Sir John Murray with a note on the composition of the material on the sea-bottom near Cape Verde, as shown by an examination of some specimens recently sent to him, one of which has been taken as typical of samples yielded by other soundings in the neighbourhood, a large proportion of minerals being present throughout. Sir John Murray says—

"The samples are evidently very similar in composition, being all dark blue muds. Only one sample was therefore examined in detail, but the percentage of carbonate of lime was determined in them all, and was found to vary from 11·33 in 1220 fathoms to 24·2 per cent. in 1080 fathoms. The following is a description of No. 30, 1210 fathoms, which may be taken as representing the composition of all the samples:—

Dark Blue Mud, coherent, clayey.

Calcium Carbonate (12·63 per cent.), consisting of the dead shells of pelagic and bottom-living foraminifera, echini spines, and coccoliths.

Residue, after removal of the carbonate of lime by weak acid (87·27 per cent.), consists of—

Minerals (35 per cent.), m. di. 0·08 mm., angular and rounded, quartz, mica, etc.

Siliceous organisms (3 per cent.), sponge spicules and diatoms.

Fine washings (49·27 per cent.), amorphous clayey matter and small indeterminable mineral particles."

Prof. Milne, in his paper upon "Sub-Oceanic Changes," published in the *Geographical Journal* for August and September, 1897, makes mention of submarine springs as tending to disturb the accumulation of loose material which covers the slopes fringing the submarine plains bounding most continents; while striking illustrations of underground streams are, he says, to be met with in many countries.

To quote further from Prof. Milne's instructive lecture delivered before the Society would be an unwarrantable repetition, but it may be said that the prominent notice he bestows on submarine disturbing actions and changes of the sea-bottom, and the discussion on the subject, in which Sir Archibald Geikie, Mr. R. K. Gray, Mr. M. H. Gray, and Admiral Sir William Wharton took part, demonstrates the interest evoked in the minds of men competent to deal with the question. It only requires further and more complete surveys of the localities within our knowledge to place the facts beyond doubt.

The limits to which water gravitates into the earth is beyond the powers of direct observations, but, as it is known from the formation of many basins, that the strata of which they are composed reaches a thickness of from 20,000 to 30,000 feet, it is reasonable to infer that they are permeated by water to an equal depth. It would be equally reasonable to infer from this, that artesian outbursts may,

and very likely do, occur at various depths in which submarine cables are laid. At the depths below the surface of the Earth's crust mentioned, the temperature would be such as to convert water into steam. So far we have no record of violent disturbing action causing breaks to submarine cables in depths approaching 3000 fathoms, or = 18,000 feet.

In pursuing our inquiries into this subject, it is needful to try and trace back from the effect to the cause. Therefore, from the broken cable at the bottom of the sea, torn asunder by invisible and titanic force, we have two fields of speculation open to us, one is the theory of earthquakes, the other that of sub-oceanic convulsions from other causes. These may be displacements of portions of the bottom where the slopes created exceed the angle of repose; or they may be subsidences due to "caving" in of parts of the shell over cavities in the core of the Earth. The two theories are inter-related; a slight earth-tremor might be sufficient to develop a fracture where tension exists at a weak place, and open a vent for pent-up forces within. It may be that the constant action of the flowing water, and pressure thereon, forces it to work out its own destiny, and the stress in the dark places under the earth is relieved by an outbreak under the ocean.

Dr. H. R. Mill, in the 'Realm of Nature,' "On Underground Water," section 312, says, "It is estimated that one-third of the rain which falls upon the surface of the Earth in a region like Great Britain, for example, sinks into the ground, and that the greater part of it returns to the surface at a level lower than it started from."

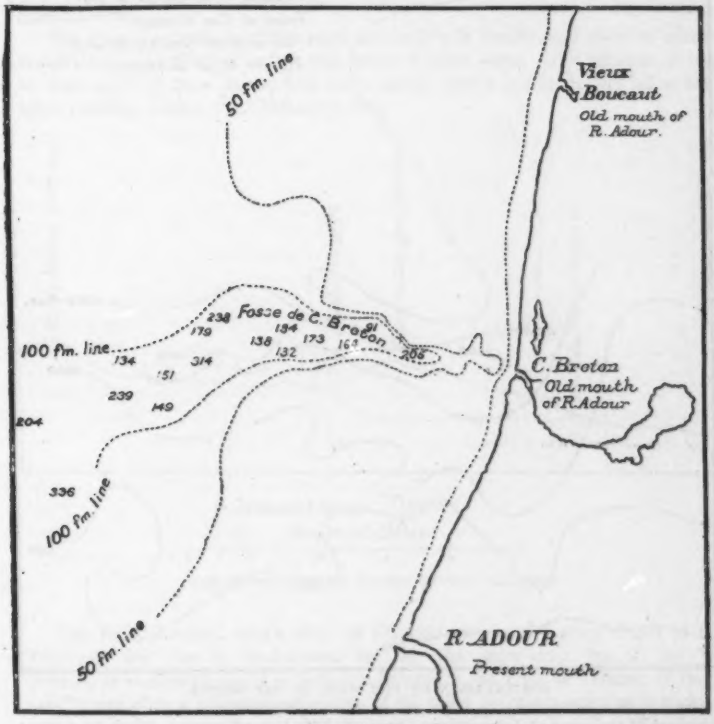
In section 317, "On Caverns," Dr. Mill makes reference to the extensive limestone caverns of Adelsburg in Austria, the Mammoth cave in Kentucky, and the Yenolan caves in New South Wales; also to the underground rivers that flow through them, and to the existence of blind fish therein. Dr. Mill says that "in all limestone regions rivers disappear beneath the surface, and although some reappear on land, several vanish altogether, and ultimately well up through the salt water of the sea, sometimes from depths of 100 fathoms or more."

"Even in the earliest antiquity," as is remarked by M. Martel in his deeply interesting lecture on Speleology during the Sixth Geographical Congress in London in 1895, "springs, caves, and underground rivers always excited human curiosity."

Many caves are without visible communication with the external world, and the entrance to others concealed by rocks in solitary ravines on hill slopes or steep seashores. It may thus be inferred that a vast number of caves and underground river outlets must still be totally unknown. As the streams that flow on the surface of the Earth alter their course in the lapse of time, so also are the subterranean waters active in excavating new channels and finding at length fresh outlets on a lower level. The Adelsberg cave is a remarkable instance of the changes that subterranean waters, aided by time or by the disruptive power of earthquakes, may bring about.

M. Martel, in his address to the Sixth Geographical Congress in London in 1895, modestly says that he was lucky enough to discover, from 1888 to 1894, by means of quite a new method of cave-hunting, grottoes miles in length, hung with enormous stalactites; underground rivers, never yet traced; subterranean lakes overhung with a sparkling canopy of crystallization—a whole world, dark and hidden, transformed into fairy palaces under the magnesium light. These wonders are in the region of the Causses in Southern France, which forms the southern slope of the central plateau; and the western declivity of the Cévennes, a genuine limestone tableland built up during the second geological epoch, at the bottom of the Jurassic sea, to the thickness of more than 1600 feet by the accumulation of grains of sand and organic remains.

It would be beyond the scope of this paper to make lengthy reference to this elaborate history of these explorations, although the temptation to enlarge upon the subject is keen. Imagine such a subterranean river as that of Bramabiau, in the department of the Gard, France, with its seven cascades, its tributaries of Le Bonheur, de la Trouche, and La Riviere du Sud, with its four miles of galleries, great halls, basins, tunnels, fissures, avens, or swallow-holes, and ramifications of bewildering extent. Then the subterranean river of Padirac, 2 miles long, at a depth below the plateau du Causses de Gramat of 350 metres, and only think that such discoveries may yet be made as may probably outdo these in extent,



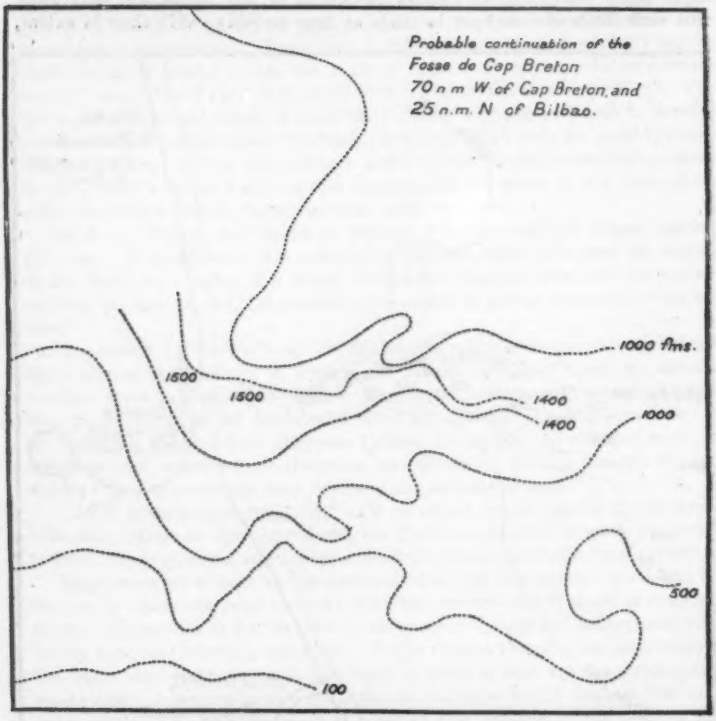
FOSSE DE CAP BRETON.

then it will not be wondered at that submarine outbursts of pent-up waters occur below sea-level.

As will be seen from these references to M. Martel's experiences, France in its continental features presents unrivalled testimony of magnificent geological changes, not only underground, extending over the immense area of the Causses, and in the departments of the Gard and the Vaucluse, but upon her coasts, the western sea-board exhibiting some most striking alterations.

There is a remarkable gully formation to the north of Bayonne, called the Fosse de Cap Breton, near to and coincident with the geological boundary between the regions of the Pyrenees and the Landes; the contour of this gully is shown on the

Admiralty charts of the date of 1887. In the fourteenth century the mouth of the Adour river existed here, and prior to that period Cap Breton was an important seaport, which gave its name to the island of Cap Breton, in North America.* The first change in the course of the river took place towards the close of the fourteenth century, during a violent storm which threw up a bar effectually blocking its outlet, the river then flowing along the rear of the dunes as far as the hamlet of Vieux Boucaut, an old mouth 22 miles north of Bayonne. The present



CONTINUATION OF THE FOSSE DE CAP BRETON.

channel of the river at Bayonne was excavated by human agency, aided by a great flood in 1571.*

It will be noticed that a large lake (L'Étang d'Ossigore) is situated to the north of Cap Breton, and another, a larger one, farther inland to the east. That the waters of these lakes communicate with the sea through the permeable sands at the old mouth of the river Adour there can be no doubt whatever, and it is extremely probable that a flow of sediment, forming a slow but irresistible avalanche, makes its way through the Fosse, which is the old river-bed, to a considerable distance out to sea.

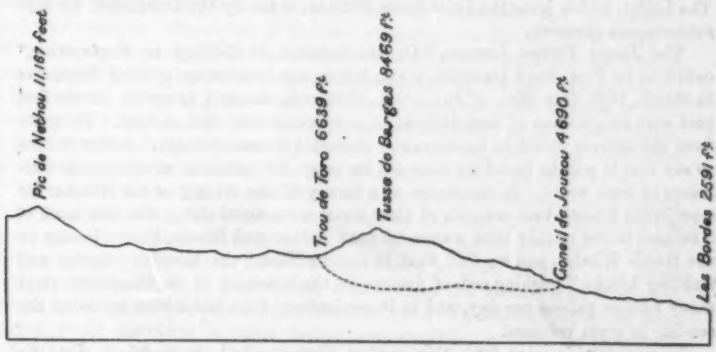
The frequent breaks to the Bilbao Lizard cable of the Direct Spanish Telegraph

* Reclus, *Nouvelle Géographie Universelle*, p. 112.

Company during several years after it was laid in 1872, at a position right in line to the westward of this submarine gully, may have been caused by this movement of mud and detritus, aided by the "resaca" of great waves, and the heaping up of water in the bay during westerly gales.

North of Cap Breton to the 44th parallel along the coast of the Landes are several extensive lakes, as shown by the Admiralty charts, all having communication with the sea at the surface. Two of these, L'Étang de Biscarosse L'Étang de Cazan et de Sanguinet, are connected, apparently by a canal, and find an outlet by Mimizan. All of these outlets are small, and would appear to be inadequate to carry away into the sea the surplus of water which flows into these lakes from inland sources.

The lines of soundings off the coast are uniformly similar, and show no exceptionally deep ruts off these outlets that would indicate scour. The inference would be that much of these waters find their escape farther out at depths below sea-level, probably outside the 100-fathom line.



Natural Scale 1:150000.

Scale of Miles

0 1 2 3 4 5.

THE SUBTERRANEAN COURSE OF THE GARONNE.

The river Garonne, which rises on Spanish soil, on the steep slopes of the Pyrenees, and has a head-stream fed by the snow and ice of the Pic Nethou, is swallowed up by a sink-hole known as the Trou de Taureau ("Bulls' hole"), and after a subterranean course of 2½ miles reappears again as a gushing spring at the Goueil de Joueou ("God's eye"), at the hill of Castellon. This head-stream of the Garonne is joined by a second river of that name which traverses the Spanish valley of Aran, and when it enters French territory at the defile of St. Béat it is already a formidable river.*

Between the 44th and 46th parallels, and north of the Bassin d'Arcachon are a chain of small lakes leading into l'Étang de Lacanau; a few miles north of this is L'Étang de Carcans et d'Hourtin, a lake of considerable extent with no visible outlet to the sea. The soundings off the coast here also are uniform, and give no indication of scour due to surface outlet.

* Reclus, p. 111.

The river Touvre, a tributary of the Charente, flows for a considerable portion of its course through subterranean channels. This river is fed by the Tardoue and the Bandiat, both of which take their rise on the granite plateau of Central France, and the bulk of the water from these two rivers in turn likewise finds its way through a fissured and cavernous region into the Touvre. From these known instances, it is more than probable that the whole region of the department of the Charente and the Landes, to the Basses Pyrenees, present similar subterranean features to those so graphically set forth by M. Martel in 'Les Abimes.'

The geological agencies which have severed Cornwall from ancient Armorica, and have reduced Brittany to its existing dimensions, have been likewise active along the coast from the Loire to the Gironde.

"In the Neolithic age,
When the prehistoric spring made the piled Biscayan ice-pack split and shove . . .
Straight on the glittering ice-field by the caves of the lost Dordogne."

KIPLING.

The Loiret, which joins the Loire below Orleans, is fed by the Loire itself through subterranean channels.

The James Forrest Lecture, "On the Relation of Geology to Engineering," delivered by Prof. Boyd Dawkins, F.R.S., before the Institution of Civil Engineers in March, 1898 (see *Min. of Proc.*, Oct., 1898, vol. cxxxiv.), is replete in the first part with information of deep interest in connection with this subject. To quote from the address would be inadequate. It should be read through. Suffice it now to say that it will be found we have not far to go for instances of submarine outbursts of fresh water. In the course of a survey of the estuary of the Humber for a projected tunnel, vast volumes of clear water were noted rising like the head of a column in the muddy tidal waters between Barton and Hessle, known locally as the Hessle Whelps, and we find that in eastern Kent "the babbling streams and tinkling brooks" gushing out of fissures in the foreshore of St. Margaret's yield many million gallons per day, and in Dover harbour fresh water rises up below the sea-line in great volumes.

In pushing inquiry into this subject farther afield, it is found that the antipodes presents some very important features, South Australia taking a foremost place in the extent of its artesian areas. A recent geological examination by Mr. H. Y. L. Brown, the Government geologist, shows a large area of the colony to embrace a wide cretaceous basin extending from the Queensland and New South Wales borders to the outcrop of bedrock near Farina, the limits on the north and west being undefined, but, as far as can be ascertained, embracing an area of nearly 100,000 square miles. The river system of this part of the island continent is unique. Taking the Murray, for example, there are evidences at many places along its course of disappearances of vast bodies of water by percolation. Between Albany and Howlong gaugings show a loss equal to 0·144 foot per day in 40 miles. Evaporation is believed to account for 0·041 foot per day, leaving 0·130 foot per day for loss by leakage, this being equal to more than five million gallons per day. During the same year that the Murray at Mildura discharged but 10 per cent. of the rainfall in the watershed of Echuca, higher up the stream it discharged 20 per cent. of the measured fall. This shows filtration on a large scale. The same remarkable diversion of their waters underground applies to most of the Australian rivers. There is a smaller proportion of the rainfall accounted for by visible bodies of water in them than in the rivers of any other part of the world.

Mr. R. L. Jack, and a Fellow of the Society, in his paper on "Artesian Waters in the Western Interior of Queensland" (*Geological Survey Bulletin*, No.

1, Brisbane, 1895), gives the name of bibulous Blythesdale Braystone to an absorbent sandstone found at the base of the Lower Cretaceous formation at Blythesdale, near Roma. This braystone outcrop is crossed by several large streams and the eastern tributaries of the Thomson river, and while the waters are running the bibulous rocks are absorbing them greedily; not only does the water spread laterally, but it fills up the underground portion of the strata that has been emptied by leakage. It is supposed, and believed to be actually the case, that the outcrop of these beds occurs at gradually lower levels until it attains the sea-level, and it is also supposed that the beds dip seaward, and beneath the sea, and either dip at a lower angle than the slope, or rise to the lower level of the ocean-bed. Evidence that leakage of this kind has actually taken place was presented by Prof. David, who, in November, 1893, described powerful springs of fresh water at Port Macdonnell, rising up from the floor of the ocean, and discolouring the water for some distance around.

In other regions of the Eastern Hemisphere the river systems are distinguished by exceptional characteristics. Take the Malabar and Coromandel coasts, for example. The rivers of Malabar, excepting the Ponani, which rises on the east of the Anamalate hills, have but short courses, and reach the sea through independent channels, but farther south they discharge into riverain lagoons, known as backwaters. In many places these lagoons are disposed in two or three or more lines parallel with the coast, and the whole seaboard appears to have been formed by beaches successively deposited by the sea, and then separated from each other by shallows, where the salt water has been gradually replaced by fresh water.

The aspect of the surface waters goes to show that from some cause, probably artesian, considerable disturbances take place on the bed of the sea along the Coromandel, Ceylon, and Malabar coasts. At several points stretches of muddy water, coloured yellow or red, have been seen, even in great depths. The waves break around the edges of these spaces, within which the surface always remains smooth, or slightly disturbed in an undulating form. Vessels take refuge on these patches, which also form favourite feeding and spawning grounds for multitudes of fish. No marine region deserves more careful study than these turbid islands, encircled by clean water; they seem to teem with myriads of animalculæ, changing the liquid element to the consistency of mud.*

Pondicherry, it may be here remarked, is now supplied with good water from artesian wells sunk to depths of hundreds of feet.

While studying the views of one of the New South Wales authorities before cited, the writer was struck with one or two very interesting items of information, which would appear to be intimately related with the subject under consideration.

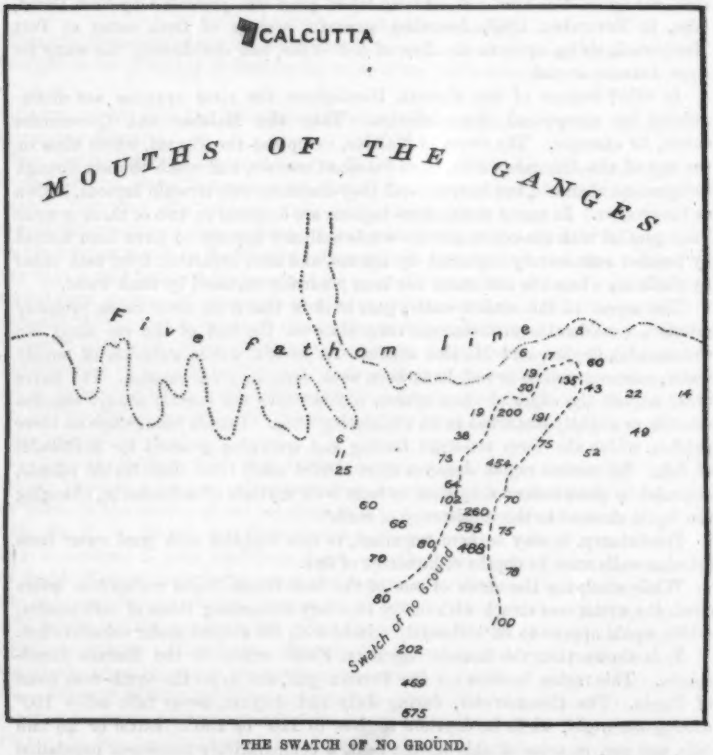
It is shown that the hottest region on Earth exists in the Eastern Hemisphere. This region borders on the Persian gulf, and is on the south-west coast of Persia. The thermometer, during July and August, never falls below 100° *during the night*, while in daytime it rises to 120° or 130°. Little or no rain falls, and yet, in spite of this terrific heat, a comparatively numerous population contrive to live, slaking their thirst from the copious springs of fresh water which burst forth from the *bottom of the sea*. These supplies can only be derived from rain-water which has sunk into a porous stratum some distance inland, and discharges itself at a point where it meets an insufficient retaining pressure, and which, in this case, would appear to be at an outcrop of the porous stratum in the ocean-bed.

The Nubian desert takes more than equal rank in point of warmth of climate.

* Reclus, vol. viii. p. 531.

Here food may be cooked by being buried in the sand. The Arabs say of it, "The soil is like fire, and the wind is like a flame." This desert, however, will, it is said, undergo a great change under the influence of British colonization and the artesian borer's drill; it will vie with the great Sahara in its wonderful transformation since the advent of its artesian water-supplies.

At the estuary of the Ganges, south of the Murgattah and Bangarah rivers, is a singular submarine gully depression, from 6 to 12 miles broad, called the "Swatch of no ground," the north part being in latitude 21° 24′ N. Here the depth suddenly drops from 20 fathoms to 135 fathoms; and at about

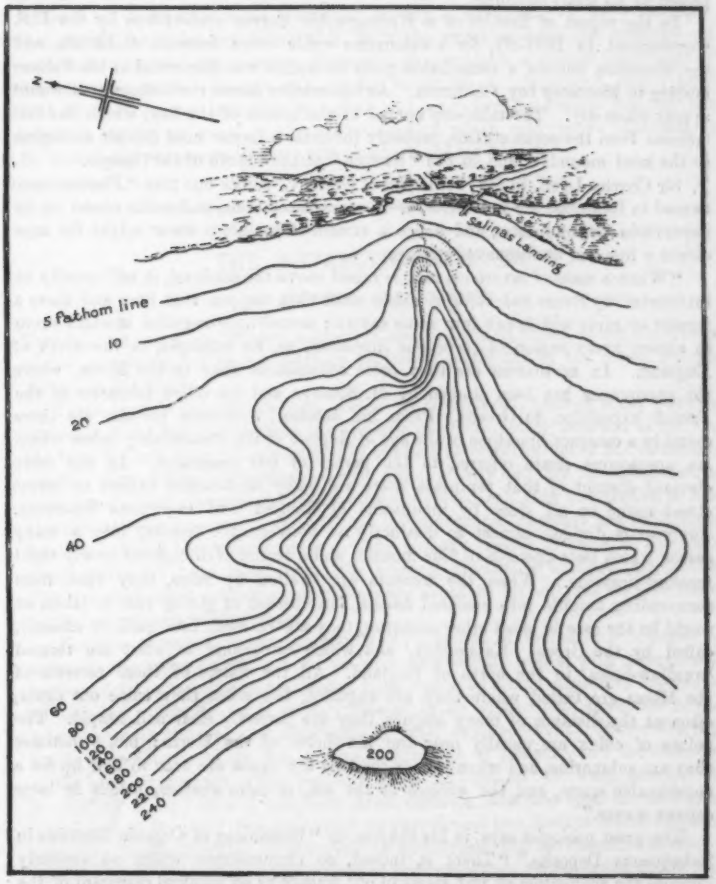


THE SWATCH OF NO GROUND.

30 miles to south-south-west a depth has been found of 454 fathoms; and at 40 miles, of 595 fathoms. Two miles north of this greatest depth is a sounding of 260 fathoms, which shows an elevation of 2010 feet in the ocean floor, and the very steep grade of 30°. Six miles to the south-eastward of that sounding is found a depth of 488 fathoms, or an elevation of 642 feet. Another similar remarkable feature, about 30 miles to the south of the 595 fathoms' sounding, is a depth of 202 fathoms, with 469 fathoms and 675 fathoms at 8 and 12 miles distant respectively. No indication of the character of the bottom is given on the Admiralty chart. This is to be regretted, because it leaves in doubt a very important point as to whether

these elevations, both inside and outside this very curious gully, are of hard mud or rock.

Mr. J. Y. Buchanan, F.R.S., has pointed out, in speaking of the Congo, that all marine muds settle down in a state of very considerable consistency, so that it is quite likely that these elevations are mounds of mud which have been deposited by



SALINAS LANDING, MONTERY BAY, CALIFORNIA. CONTOUR OF SEA BOTTOM.

the centripetal motion of the eddies occurring in the tidal waters at certain spots. Captain Ritchie, an old author who surveyed the surface of the Sunderbunds, says of the low islands lying on the outer edge of the Ganges river outlets, that the bank proper is cut through and channels are formed, that these channels have no definite trend, and that they all offer safe ground for anchorage, with an increasing

depth of water *towards the land*. The nature of the ground in the channels is soft towards the shores, but the ground will suddenly be found hard and in terraces as the depth decreases. There is evidently a scour through the "Swatch" that keeps it from filling up with the sediment brought down in such vast masses by the surface river outlets, and it is possible that it is the ancient bed of the river which existed before the formation of the multitude of islands through which the river passes by its many channels.

In the report of Results of a Hydrographic Survey undertaken by the U.S. Government in 1891–92, for a submarine cable route between California and the Hawaiian islands, a remarkable gully formation was discovered at the Salinas landing in Monterey bay, California. An illustration shows the bottom as it would appear when dry. The table-top mound at the mouth of the bay, which lies 200 fathoms from the ocean surface, probably indicates a former mud deposit analogous to the mud mounds found in the "Swatch" at the mouth of the Ganges.

Sir Charles Lyell, in his 'Principles of Geology,' points out that "Fissures once formed in limestone are not liable, as in many formations, to become closed up by impervious clayey matter, and hence a stream of acidulous water might for ages obtain a free and unobstructed passage. . . .

"When a mass of cavernous rock is raised above the sea-level, it will usually be intersected by rivers and valleys, and it must then happen that here and there a torrent or river will break into some cavern; accordingly engulfed streams occur in almost every region of cavernous limestone, as, for example, in the north of England. In no district are they more conspicuous than in the Morea, where the phenomena has been studied by M. Boblaye and his fellow-labourers of the French expedition to Greece. From his account, numerous caverns are there found in a compact limestone of the age of English chalk, immediately below which are arenaceous strata referred to the period of our greensand. In the more elevated district of that peninsula there are many land-locked valleys or basins closed round on all sides by mountains of fissured and cavernous limestone. The year is divided, almost as distinctly as between the tropics, into a rainy season which lasts upwards of four months, and a season of drought of nearly eight months' duration. When the torrents are swollen by rains, they rush from surrounding heights into enclosed basins, but instead of giving rise to lakes, as would be the case in most other countries, they are received into gulfs or chasms, called by the Greeks 'Katavothra,' and which correspond to what are termed 'swallow-holes' in the north of England. All the waters of these torrents of the Morea are turbid where they are engulfed, but when they come out again, often at the distance of many leagues, they are perfectly clear and limpid. The points of efflux are usually near the sea-shores of the Morea; but sometimes they are submarine, and when this is the case the sands are seen to boil up for a considerable space, and the surface of the sea, in calm weather, swells in large convex waves."

The great geologist says, in his chapter on "Imbedding of Organic Remains in Subaqueous Deposits," "There is, indeed, no circumstance which so seriously impedes the acquisition of just views in our science as an habitual disregard of the important fact that the reproductive effects of the principal agents of change are confined to another element—to that larger portion of the habitable globe from which, by our very organization, we are almost entirely excluded."

In conclusion, I may say that in my reference to underground rivers, artesian waters, and submarine springs in various parts of the world, I have necessarily omitted mention of much interesting matter.

An account of the lost rivers, sink-holes, etc., that abound in North America;

the caverns of the Ohio valley, and of Canada; the underground cavities and waters of some of the West India islands and Brazil, would alone form a voluminous paper. In England and Ireland the investigations of Professors Boyd Dawkins and Edward Hull have, amongst others, disclosed caves, swallow-holes, and other evidence of subterranean waters whose existence was previously ignored.

In this paper readers may notice some apparent contradictions. These arise through my desire to place before the Society, not only my own views, but also those of many whose opinion I consider worthy of mention. I have recorded these views, as I do not think that, with the small amount of evidence we have before us, any one, however distinguished, can claim a perfect knowledge of the causes at work. We are only on the threshold of the subject, and I hope that the data I have been able to collect and lay before my readers will set the thinking minds at work, and produce an effect which may prove beneficial to the knowledge we possess of the world in which our lot is cast.

THE ANTARCTIC CLIMATE.

By HENRY ARCTOWSKI.

THE following is a preliminary account of some of the additions to our knowledge of the meteorology of higher southern latitudes contributed by the recent Belgian Antarctic Expedition.

These desolate antarctic regions, still so little explored, present many physical problems of the highest interest; the question of their climate, attacked as early as the time of Croll, must prove a subject of exhaustive investigation in the immediate future. The results I have obtained were not originally intended for publication in their present form, because the mean values involved can only be regarded as first approximations; however, it appears that my provisional numbers are sufficiently exact to indicate the general nature of the climatic *regime* in parts of the globe about which we have been, up to the present, practically without information. The fact that other antarctic expeditions are about to set out has decided me to publish my figures as they stand.

For the purposes of our inquiry, it is a matter of indifference whether an antarctic continent exists or not; we have undoubtedly to deal with a continuous surface of ice, which the meteorologist must regard as a land surface as opposed to an open sea. This ice-cap is entirely isolated by an ocean which surrounds it, and is subjected to the peculiar conditions of polar day and night. Hence the first points to be considered are the average distribution of pressure, and the direction of the prevailing winds. The positions (about 81° and 95° W. long., and 69° 50′ and 71° 30′ S. lat.) show a relatively small distance from the open sea and great distance from the pole. In consequence we experienced two distinct types of climate according to the direction of the wind—a continental and an oceanic—in effect a coastal climate depending on the passage of cyclones which varied in frequency with the seasons. This seems to be the key of the whole position. As regards details, I take into consideration the mean and minimum temperatures and the barometric pressures, the direction of wind, the amount of cloud, and the amount of precipitation.

Table I. gives the mean values obtained from hourly observations of temperature made on board the *Belgica* during her drift in the ice.

July was the coldest month; its mean temperature was −23°·5 C. (−10°·3 F.), and the lowest temperature observed during the month, −37°·1 C. (−34°·8 F.).

The extreme minimum of temperature was observed in September, −43°·1 C. (−45°·6 F.).

The warmest month was February, with a mean temperature of −1°·0 C. (30°·2 F.), and minimum for the month, −9°·6 C. (14°·7 F.).

If we regard June, July, and August as the antarctic winter months, and December, January, and February as summer, we may take it that the mean winter temperature is −16°·8 C. (1°·8 F.), and the mean for summer −1°·5 C. (29°·3 F.).

Table II. shows the minimum temperature for each month. The maximum temperatures are less interesting; the winter average is −1° to 0° C. (30° to 32° F.); the absolute maximum for the equinoctial months is 0° to 1° C. (32° to 34° F.), and for summer 2° C. (36° F.).

These tables show that between the seventieth and seventy-first parallels of the southern hemisphere, and amid the ice of the antarctic ocean—first, the mean temperature is lower than that of the northern coast of Spitsbergen (Mossel bay, 1872–73, −8°·9 C. (16° F.)); second, the minimum temperature is quite as low as the minima observed on the east side of Greenland (Sabine island and Scoresby sound); and third, that the mean temperature of the three summer months is lower than the corresponding mean in the ice of the arctic ocean—the observations of the *Fram* give a mean for June, July, and August of −1°·2 C. (29°·8 F.). Note that the calculations of Spitaler and Supan give a mean temperature for the parallel of 70° N. lat. of −10°·2 C. (13°·6 F.). If we consider that a considerable fraction of the seventieth parallel of south latitude is land, we can suppose that it may have a mean temperature as low as the 70° N., and include a pole of cold with lower temperature as the Asiatic or North American poles of cold.

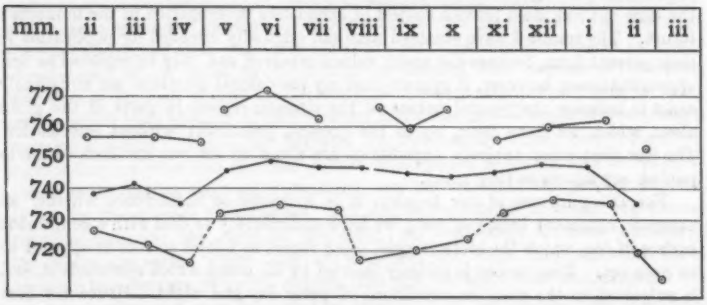


FIG. 1.

As in the case of the mean temperatures, the values I am able to give for mean barometric pressure must be regarded only as first approximations. During our drift in the pack-ice hourly observations were made with a marine barometer and with an aneroid. I have not yet been able to apply exact corrections to these observations, but if we bear in mind that while the temperature correction is negative, the correction for latitude is positive, and that for temperatures about 13° to 15° C. (55° to 60° F.), these corrections are numerically nearly equal, we can accept the uncorrected values as near enough for our present purpose. Table III. gives the averages of the aneroid observations, calculated to whole millimetres only. The mean for the year is 744·7 mm. (29·319 inches).

Tables IV. and V. give the principal minima and maxima of pressure observed, the values are reduced to the freezing-point and gravity at 45° lat. The lowest

pressure observed during our wintering was 711·74 mm. (28·022 inches), and the highest 772·14 mm. (30·400 inches), a range of 60·40 mm. (2·378 inches). Table VI. gives the monthly variations of the barometer, the mean value of which amounts to 34·30 mm. (1·350 inch), showing even more clearly than Table IV. that the cyclonic belt extends beyond the polar circle. From this table it appears, further, that the three months of almost continuous daylight (November, December, and January) are characterized by a very small variation of pressure—only 23·95 mm. (0·943 inch). The three corresponding months of winter have also a mean less than those for the intermediate or equinoctial months. Compare this with the mean pressures (Table III.): the differences between the annual and monthly means (Table VII.) show that February, March, and April form a negative group, in which the pressure is relatively low; the three months of polar night form another group of maximum barometric pressure; then follow August, September, and October, months of decreasing pressure, a group which, although not actually negative, forms a distinct secondary minimum; and, lastly, three months of polar day forming a secondary maximum of pressure. The general result is illustrated in Fig. 1—high pressure at the solstices, low pressure at the equinoxes—and the existence of a direct simple relation between the barometric pressure and the progress of the sun is at once obvious.

Table VIII. gives the observed wind-directions: the figures indicate the number of hours during which the wind blew from each direction during the twelve months, the sums constituting the "wind-rose," of the point of observation. Fig. 2 shows that winds blow from northerly and southerly points with almost equal frequency, and that easterly winds predominate over westerly. The directions of greatest frequency were west, east, and north-east.

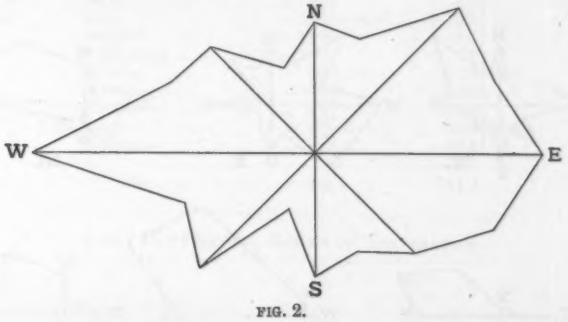


FIG. 2.

The monthly wind-roses show some interesting seasonal variations in the prevailing directions of the wind; we note specially the predominance of north-east to south-east over westerly winds from November to February, and the relative frequency of westerly winds during June, July, and August (Fig. 3). The figures show that on the whole the station was beyond the westerly wind region, although at certain seasons the westerly system did extend as far south.

Some further points must be referred to in describing the climatic conditions we experienced. The temperature of the air is doubtless the most important element in the study of climate; but it seems to me that its importance is relatively less in polar regions than in other parts of the globe. In polar latitudes the human organism is chiefly influenced by the absence of the sun during the night of winter. In the summer, on the other hand, the radiant heat of the sun is so strongly

concentrated that the temperature of the air scarcely measures the warmth we feel. Further, the action of the solar rays is directly beneficial—the sun strengthens and reanimates. And besides direct insolation, the diffused daylight itself must be considered—one feels quite different under a cloudless vault and under a sky overcast and sombre. The presence or absence of the sun is a much more important matter to us than the state of the thermometer.

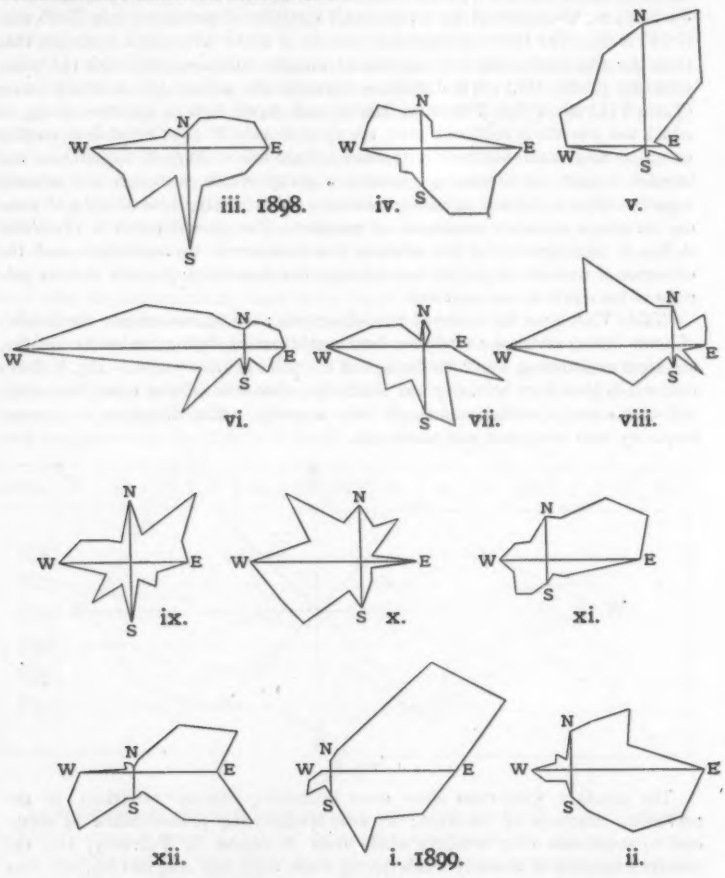


FIG. 3.

The wind is another extremely important factor from the physiological point of view. In calm weather a temperature of $-20°$ C. ($-4°$ F.) is quite tolerable, even agreeable if the sun is shining; but with a light breeze one feels the cold at once, and in strong wind it is impossible to remain long in the open air with so low a temperature. It appears to me that humidity plays a quite secondary part in the physiology of the polar climate, at least at low temperatures; in any case the humidity of the atmosphere rarely makes itself felt.

Some actinometric observations will serve to indicate the intensity of radiant heat. At 2 p.m. on December 30, the temperature of the air being −0°·2 C. (31°·6 F.), the black-bulb thermometer read 45°·1 C. (113°·2 F.) in the sun, which explains why in reality the weather felt very warm.

The sky was usually overcast, most frequently with a thick layer of stratus, which formed a uniform grey covering, and often persisted for days or even weeks together, with only short breaks. Table IX. shows the state of the sky during each month of the year.

The number of days during which the air did not remain saturated, *i.e.* on which the hygrometer indicated a humidity of less that 90 per cent., was—October, 12, November, 18; December, 22; January, 15; and February, 11.

If we include ice-deposits from fog and similar precipitation, we find that snow-fall is recorded on 257 days of the year, made up as shown on the first column of Table X. The second column of Table X. shows the number of days on which rain (even a few drops) was recorded. Speaking generally, it may be said that the weather was extremely cloudy, that fogs were frequent, that snow fell on many days, and that the air was saturated nearly the whole time.

Table XI. gives particulars with regard to wind-force.

TABLE I.—MEAN TEMPERATURE.

		°C.		°F.	
1898.	March	− 9·1		15·6	
	April	−11·8	− 9·1	10·8	15·6
	May	− 6·5		20·3	
	June	−15·5		4·1	
	July	−23·5	−16·8	−10·3	1·8
	August	−11·3		11·7	
	September	−18·5		− 1·3	
	October	− 7·9	−11·1	17·8	12·0
	November	− 6·9		19·6	
	December	− 2·2		28·0	
1899.	January	− 1·2	− 1·5	29·8	29·3
	February	− 1·0		30·2	
	Year	− 9·6		14·7	

TABLE II.—MONTHLY MINIMA OF TEMPERATURE.

		°C.	°F.
1898.	February 23, at 10 p.m.	− 7·6	18·3
	March 15, at 4 a.m.	−20·3	− 4·5
	April 3, at 6 p.m.	−26·5	−15·7
	May 29, at 8 p.m.	−25·2	−13·4
	June 3, at 6 p.m.	−30·0	−22·0
	July 17, at 10 p.m.	−37·1	−34·8
	August 28, at 3 a.m.	−29·6	−21·3
	September 8, at 4 a.m.	−43·1	−45·6
	October 25, at 3 a.m.	−26·3	−15·3
	November 2, at 4 a.m.	−21·4	− 6·5
	December 2, midnight	−14·5	5·9
1899.	January 2, at 2 a.m.	− 8·1	17·4
	February 11, at 2 a.m.	− 9·6	14·7
	March 4, midnight	−12·0	10·4

TABLE III.—MONTHLY MEANS (APPROXIMATE) OF BAROMETRIC PRESSURE.

		mm.	Inches.
1898.	February *	738·5	29·075
	March	741·4	29·190
	April	735·6	28·961
	May	746·3	29·382
	June	749·5	29·508
	July	747·8	29·441
	August	747·2	29·418
	September	745·5	29·351
	October	744·7	29·319
	November	746·0	29·371
	December	748·2	29·457
1899.	January	747·3	29·422
	February	736·5	28·997
	Year	744·7	29·319

* Latter half of month only.

TABLE IV.—MINIMUM PRESSURES OBSERVED.

		Reduced to freezing-point.		Reduced to freezing-point and lat. 45°.	
		mm.	inches.	mm.	inches.
1898.	February 18, at 6 a.m. ...	724·53	28·526	725·93	28·581
	March 22, at 4 a.m.... ...	719·96	28·345	721·48	28·405
	April 20, at 3 a.m.	714·66	28·136	716·15	28·195
	May 10, at 11 p.m.	730·26	28·751	731·78	28·811
	June 21, at 1 a.m.	733·58	28·881	735·11	28·941
	July 31, at 2 a.m.	731·77	28·811	733·28	28·870
	August 12, at 4 a.m. ...	715·81	28·182	717·31	28·241
	September 22, at 6 a.m. ...	719·29	28·319	720·77	28·377
	October 23, at 4 a.m. ...	722·06	28·428	723·53	28·486
	November 19, at 3 p.m. ...	731·33	28·793	732·82	28·852
	December 22, at 10 p.m. ...	735·52	28·958	737·01	29·016
1899.	January 30, at 10 p.m. ...	733·92	28·895	735·43	28·955
	February 17, at 11 p.m. ...	718·59	28·292	720·08	28·350
	March 2, at 3 a.m.	710·26	27·963	711·74	28·022

Absolute minimum, 711·74 = 28·022 inches.

TABLE V.—MAXIMUM PRESSURES OBSERVED.

		Reduced to freezing-point.		Reduced to freezing-point and lat. 45°.	
		mm.	inches.	mm.	inches.
1898.	February 11, at 4 p.m.	755·82	29·757	757·11	29·808
	March 29, at 1 a.m. ...	755·35	29·739	756·95	29·802
	April 26, at 7 a.m. ...	753·80	29·678	755·37	29·739
	May 13, at 4 p.m. ...	764·28	30·090	765·90	30·154
	June 11, at 1 a.m. ...	770·48	30·334	772·14	30·400
	July 18, at 8 p.m. ...	761·53	29·983	763·10	30·044
	August 29, at 6 p.m. ...	765·43	30·135	766·99	30·197
	September 16, at 9 p.m.	757·77	29·834	759·31	29·894
	October 12, at 8 a.m. ...	764·80	30·111	766·35	30·172
	November 13, at 4 a.m.	754·05	29·688	755·58	29·748
	December 18, at 5 a.m.	757·65	29·829	759·20	29·890
1899.	January 24, at 8 p.m. ...	760·76	29·951	762·33	30·013
	February 22, at 3 a.m....	751·63	29·593	753·17	29·653

Absolute maximum, 772·14 mm. = 30·400 inches.

TABLE VI.—MAXIMUM VARIATIONS OF PRESSURE, AND MEANS OF THOSE VARIATIONS.

	mm.		inch.
1899. February	33·09		1·303
1898. March	35·47	35·93	1·397
April	39·22		1·544
May	34·12		1·343
June	37·03	33·66	1·458
July	29·82		1·174
August	49·68		1·955
September	38·54	43·68	1·518
October	42·82		1·686
November	22·76		0·897
December	22·19	23·95	0·874
1899. January	26·90		1·059
Mean	34·3 0		1·350

Extreme range for the year: 772·14 − 711·74 = 60·40 mm.
30·400 − 28·022 = 2·378 inches.

TABLE VII.—DIFFERENCES OF MONTHLY MEANS OF PRESSURE FROM THE MEAN OF THE YEAR.

(The + sign indicates pressure greater than the mean, the − sign pressure less than the mean.)

	mm.	Inches.	
1899. February	−8·2	−0·323	
1898. March	−3·3	−0·130	minimum.
April	−9·1	−0·358	
May	+1·6	+0·063	
June	+4·8	+0·189	maximum.
July	+3·1	+0·122	
August	+2·5	+0·098	
September...	+0·8	+0·031	2nd minimum.
October	0·0	0·000	
November	+1·3	+0·051	
December	+3·5	+0·138	2nd maximum.
1899. January	+2·6	+0·102	

TABLE VIII.—TABLE OF WIND-DIRECTIONS.

The figures show the number of hours during which the wind blew from each direction.

	N.	N.N.E.	N.E.	E.N.E.	E.	E.S.E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W.	W.	W.N.W.	N.W.	N.N.W.
1898.																
March	14	26	38	60	68	50	34	30	82	22	64	56	78	22	22	10
April	30	22	13	27	84	64	76	59	32	21	25	20	51	49	50	31
May	100	121	72	8	17	33	4	7	9	1	2	17	65	75	61	83
June	14	22	26	33	34	25	28	9	24	8	76	38	191	87	37	16
July	22	10	1	—	24	72	31	70	54	28	48	38	81	48	25	4
August	32	14	38	29	26	9	34	5	19	10	47	56	141	76	104	38
Sept.	51	24	74	44	46	22	28	14	49	16	47	21	59	45	24	17
Oct.	47	31	46	8	45	11	7	18	41	24	69	74	91	42	83	32
Nov.	34	35	69	93	79	32	21	14	21	31	37	28	38	28	18	21
Dec.	3	12	53	92	67	107	55	16	21	24	63	58	44	5	11	7
1899.																
Jan.	8	16	124	156	104	84	52	72	20	12	28	16	8	—	—	—
Feb.	32	42	70	49	111	99	72	37	22	10	13	23	35	13	17	6
	387	375	624	599	705	608	442	351	394	207	519	445	882	490	452	265

TABLE IX.

Column 1 shows number of days of continuous fog or overcast sky.
Column 2 shows number of days with sky partially clear for several hours in succession (cloud amount 30 per cent. or more).
Column 3 shows number of days on which fog was observed.

	1	2	3
March	6	15	14
April	10	14	26
May	15	8	27
June	5	16	28
July	7	22	17
August	9	15	25
September	9	14	14
October	16	12	23
November	13	10	18
December	9	13	13
January	17	6	17
February	21	1	23

TABLE X.

Column 1 shows the number of days on which snow was recorded.
Column 2 shows the number of days on which rain was recorded.

	1	2
March	13	—
April	22	—
May	30	4
June	24	—
July	14	—
August	26	1
September	19	—
October	25	2
November	25	—
December	18	—
January	19	4
February	22	3
Year	257	14

TABLE XI.

Column 1 shows the number of days of calm, or of wind not exceeding force 1.
Column 2 shows the number of days of wind-force less than 4.

	1	2
March	0	11
April	2	5
May	3	13
June	3	11
July	15	25
August	3	15
September	7	20
October	4	11
November	8	21
December	4	21
January	5	24
February	1	12

WAS AUSTRALIA DISCOVERED IN THE SIXTEENTH CENTURY?

By EDWARD HEAWOOD, M.A.

FEW questions have exercised the minds of historical geographers more than that of the discovery of Australia. Whereas the first voyage to that country of which we have any authentic record took place in 1606, it has long been imagined, from indications on maps of much earlier date, that voyages—of which all record is now lost—were made considerably over half a century earlier, while if such were proved to have been the case, the honour of the discovery would be transferred from the Dutch, by whom the voyage of 1606 was carried out, to some other European nation, whose navigators had appeared earlier in that quarter of the globe. As is well known, the late Mr. R. H. Major, in the collection of documents edited by him for the Hakluyt Society in 1859, did more than any one to give currency to the idea of a discovery early in the sixteenth century; but his views have since met with wide acceptance, and the great probability of such a discovery has been generally allowed by subsequent writers, none of whom, however, appears to have yet undertaken a searching investigation into the grounds on which such opinion is based.

Without claiming any such character of completeness for the present contribution to the subject, it may still be not amiss to look briefly at the question as it now stands, and to point out certain lines of inquiry, which, if followed up by competent critics, might possibly lead to a further elucidation of its difficulties. The facts on which the idea above alluded to is based are briefly as follows. On a series of manuscript maps of the middle of the sixteenth century,* the region to the south and south-east of Java is occupied by a land of continental proportions, bearing round its coasts a fairly detailed nomenclature, apparently the outcome of some definite voyage of discovery. This land is separated from Java only by a narrow strait, and is actually joined in the north to Sumbawa. Although differing in minor points, all these maps present such a striking general resemblance as to leave little room for doubt that all were based on a single prototype. All are the work of a French school of cartographers, and the nomenclature is French with a certain admixture of Portuguese forms. From the fact that the map supposed to be the earliest in date (1530–36) contains the most marked signs of Portuguese influence, it has been supposed that the prototype was a Portuguese map, and that the discoveries intended to be pourtrayed were the work of navigators of that nation. Some, however, have held that the discoveries were more probably French. From a fancied resemblance of the coast-lines on these maps with those of Australia, but still more from the fact that Australia is the only large land in this quarter of the globe, it has been concluded that the coasts of Australia were first reached before the middle of the sixteenth century.

As regards the identification of the coasts with those of Australia, it may be pointed out that, setting aside differences of longitude as unimportant, and disregarding the evidently hypothetical southward extension of the coast-lines, the parts to which the definite nomenclature applies extend through 15° of latitude more than Australia and Tasmania combined. This would be a minor point were we dealing with the fanciful maps based largely on statements of old travellers, but in the case of charts supposed to be the result of a real survey, deserves at least to be noticed. Secondly, the fact that the northern point coincides roughly in latitude with Cape York

* Three of these maps, now in the British Museum, were last year published in facsimile by the late Mr. C. H. Coote, with explanatory letterpress.

is manifestly accidental, since that point really represents Sumbawa. The agreement is the accidental and quite irrelevant one between the latitudes of Sumbawa and Cape York. Again, the average direction of the north-east coast differs by at least 20° from that of Queensland, the portion of Australia presenting the nearest resemblance in this respect; while, taken as a whole, the outlines present a much more striking resemblance if we turn the map through 90°, making the east north! As regards the nomenclature, which has also been called in as a means of identification, the only terms found of any aid in the attempt have been those which might apply almost to any coast in the world (Coste dangereuse, Coste des Herbaiges, etc.); while, lastly, a difficulty arises from the necessity of supposing at least two separate voyages of discovery, one on each coast, though absolutely no record of any such exists. Thus, after all, the argument rests almost entirely on the fact that early in the sixteenth century a certain unknown map-maker drew a large land, with indications of definite knowledge of its coasts, in the quarter of the globe in which Australia is placed.

The difficulty, of course, has been to account for this map in any other way, and the following suggestions are merely put forward as a possible indication of the direction in which an explanation might be found. It will be useful, at the outset, to lay stress on one or two known facts.

Firstly, we must remember the great influence still exercised by the early travellers and writers, especially Marco Polo, on the cartography of the early part of the sixteenth century. This is shown, on the one hand, by the number of large islands strewn broadcast over the ocean to the south-east of Asia by such map-makers as Schöner; and on the other, by the persistent belief in a southern continent manifested even before the voyage of Magellan, which led to the representation of masses of land in a somewhat higher latitude, often designated Regio Patalis, a term used by Roger Bacon in the thirteenth century. A second point to be borne in mind is the fertile source of confusion introduced by Marco Polo's nomenclature of the Sunda Isles, his Java Minor representing Sumatra, while through his ignorance of the south coast of Java, he spoke of that island as Java Major* with a circuit of 3000 miles. A second Java, apart from Sumatra, constantly recurs in maps even of the close of the sixteenth century. Again, it is self-evident that the maps of the French school, or at least their prototype, were pieced together from independent sources. In their northern parts they show well the knowledge of the archipelago possessed at the time by the Portuguese; while even if the large land represented were really Australia, its incorrect position with respect to the rest of the map would have been due to manipulation by the cartographer.† Lastly, it will be a help to remember that, as lately shown by Dr. Tomaschek in his introduction to the German translation of the 'Mohit,' the Portuguese maps of the period were to a large extent based on native charts and sailing directions.

With these facts before us, if we find a map of the period showing a large land to the south-east of Asia bearing the title Jave la Grande, the natural conclusion is that the map-maker has intended it for the Java Major of Polo; more especially

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* It has been suggested that the names came to be so applied because Java was the original seat of the Javanese empire, which extended its influence also over the south part of Sumatra.

† Mr. Collingridge, who, though his conclusions may not be accepted, has brought together a useful body of facts in his 'Discovery of Australia,' suggests a political reason for the northward extension of Australia. But it may be observed that, on the supposition of fraudulent alteration of maps, it would have been as easy for the Portuguese to invent a new land as to distort a known one.

if, as is the case with the French maps, we find a lesser Java closely adjoining. On other maps of the period the name Java Major is constantly applied in accordance with Polo's narrative. Therefore, apart from other considerations, the Jave la Grande of the French maps should represent Java. Now, the cartographer—starting from the idea, natural when Sumatra became well known under its true name, that the modern Java with its comparatively small area was the Java Minor of the old traveller—would naturally place his Java Major in the unoccupied region to the south. If he sought for details as to its contour in the representations of Java Major on the maps of the period, he would merely obtain a repetition of his own Java Minor, of which, therefore, we should find a reduplication on his map. Now, it is certainly remarkable that on the earliest known Portuguese map of the islands, we do find an instance of such reduplication, though arising from another cause. The map attributed to Pero Reinel applies the name Java to the southern end of Sumatra, which is shown as separated from the rest of the island, while the true Java, greatly exaggerated in width, appears to the south-east as Sumbawa, though that island appears also in its true place. The parallel between this known case and the one we are supposing is certainly very close.* Now, if we take the so-called "Harleian" map, probably the earliest of its type, and delete those parts which are evidently hypothetical (those about which no information is given), we do obtain a striking general resemblance to Java as known at the time, with the exception only that it slopes to the south-east at an angle of about 18° with the true direction. This is at least not a greater divergence than, as we have remarked, would be found if Australia were intended; and, more than this, we have a plausible means of explaining the deviation in the case of Java, in the native charts lately reconstructed by Dr. Tomaschek, which show the whole line of the Sunda islands as running in a south-east direction.

To account for such a use of his material by the cartographer, we should suppose the original map of Java to be a rough chart intended for the use of sailors, or resulting from a voyage of discovery along the coast; either with no scale or with one unintelligible to the copyist,† who would therefore fit it into his map in accordance with his preconceived ideas. That such charts were in existence at the time is shown by Dr. Tomaschek's work, as well as by a letter of Albuquerque, to which we shall recur presently.

The only European navigators whose ships are known to have visited Java before 1530 were the Portuguese, and it is to their maps that we must look for contemporary representations of its coasts. A good idea of the state of their knowledge about this time is supplied by Dr. Hamy's paper entitled "L'Œuvre Géographique des Reinel et la découverte des Moluques," which contains some interesting facts bearing upon the present question. The writer discusses the first voyage to the Spice islands—that of Dabreu in 1511—as described by Galvano in his history of the 'Discoveries of the World.' The expedition sailed down the eastern coast of Sumatra and along the north of Java, passing between the main island and Madura, and then proceeding eastwards past the chain of smaller islands in that direction. The supposed map of Reinel already alluded to shows the main results of the voyage, but more details are given in the charts of the Pilot Rodriguez, reproduced by Santarem in his well-known Atlas. Dr. Hamy quotes from

* A curious instance of the accidental shifting of the position of an island occurs on this same map. The island of Gunong Api (Ilha de Fugo) is shown in exactly the same relation to the false Sumbawa (Java) which it really bears to the true Sumbawa.

† It has been suggested that Ptolemy's great exaggeration of the size of Ceylon was due to his mistaking the intervals between the lines drawn across native charts for spaces of a degree.

a letter of Albuquerque a statement which seems to show that Rodriguez, whose delineation of the islands is superior in many ways to that of his contemporaries, had to some extent drawn from native sources, especially from a large map by a Javanese pilot, which unfortunately was afterwards destroyed. Rodriguez's charts were on a large scale, so that we find already in existence—quite early in the sixteenth century—material such as could have been drawn upon by the French cartographer; while Parmentier's voyage of 1529 supplies the means by which such material could reach France. Dr. Hamy gives a map on which he shows in red the extent of coast-line known to the Portuguese in about 1519, and it is a striking fact that his red line, so far as Java is concerned, is absolutely identical in extent with the coasts shown on the French map on the supposition that Jave la Grande does represent Java.

As regards the contour of Jave la Grande, it is to be observed that, owing to the piecing together of the data by the cartographer, a certain amount of alteration must necessarily have been made in order to effect the junction with Sumbawa. The extreme northern portion must therefore be left out of consideration in comparing the form with that of Java. The most striking resemblance is to be seen in the south-west corner, where the bays and small islands are in close agreement with those on the coast of Java. The distance of Madura from the coast—if that island is supposed to be represented by the Isles de Mayna of the French map—is the most serious discrepancy, but this is small compared with the known shifting of positions on contemporary maps.* It is singular also that, with the other two groups further north, we have just the three islands or groups of islands, marked in red on Hamy's map as known to the Portuguese.

Coming next to the nomenclature of the French maps, we face peculiar difficulties, as the readings in many cases are evidently corrupt, and discrepancies exist between the different copies extant. This is not surprising when we think of the corruptions of names occurring in well-authenticated maps,† and that the maps we are now dealing with are possibly copies from a French prototype, itself based on Portuguese documents, which in their turn may have owed something to Arabic originals. Another difficulty arises from the paucity of names possessing any determinative value. A few points of interest however occur. One of the few legends appearing to record an actual place-name occurs near the great bay on the north-east coast, where we find the words Coste de Gracal. This exactly occupies the position of Gressie or Gressik (Agaçim of De Barros, Grece of many Portuguese and Dutch maps, Agracam of Mercator), which strangely enough was the first place on Java at which the Portuguese are known to have landed. The name was referred by Major (*Archæologia*, vol. xliv. p. 240) to a Provençal word meaning "bowl," but on the supposition that the original map-maker was a native of Provence, the case might merely be one of the substitution of a familiar for an

* See note on p. 423. Another instance might be given in the transference of two Javanese names—Tuban and Agaçim—to Celebes, on various maps of a somewhat later date.

† Perhaps the most singular corruptions are those concerned with the nomenclature of Bali and Lombok on maps of the period. In Galvano's account, Lombok is named Anjano (Aujane of Hakluyt), apparently from the great volcano Renjane, its most conspicuous feature. On certain maps this appears as Ancane, while in others again this is cut in two and applied to two islands, both names beginning with a capita ("Anc," "Ane"). In the Harleian chart it appears in conjunction with a corruption of the name of Bali, and the whole is read by Mr. Collingridge as "Anda ne barche" ("No boats go here"). The alteration in some maps of "Fin de iaoa" into "Fideida" is another striking instance of corruption.

unfamiliar word. Again, on the west coast, we find on the French maps the Baie Bresill, and, though the frequent use of this word in the geographical nomenclature of the period makes us hesitate to found any argument thereon,* it is interesting to find, from the letter of Albuquerque above alluded to, that the Javanese map seen by Rodriguez, or at least the draught of it made by him, included the "Terra de Brasyll." It is possible that this really refers to the modern Brazil, but at this early date (1512) the name had certainly not come into general use as an appellation for that country, which was still known as "Terra Sancte Crucis." Traces at least of a dual use of the term about this time occur elsewhere, especially in the confusion shown by the author of the 'Copia der newen Zeitung,' who speaks of the land of Presill as situated near a strait (? the strait of Sunda), and as extending to Malacca. Mr. Collingridge, who quotes Andrea Corsali as mentioning a land of Brazil near the Malay archipelago, imagines that these indications refer to Australia; but from the fact that Brazil wood is a well-known product of the archipelago, any eastern land of Brazil would much more probably lie within that region. Again, the large island off the coast bears the name Lama, or Lame, on the French maps, and it is conceivable that this might represent the termination of Sumatra (Camatra),† which name frequently occurs with a break in the middle on maps of the period.

It is to be regretted that the early Portuguese and Dutch maps give very scanty details respecting the western end of Java, for as the nomenclature is particularly full on the corresponding coast of Jave la Grande, a comparison would be likely to prove interesting. The occurrence of Cap de Grace on this coast has led to the suggestion of a discovery by Provençal navigators, more especially as one copy of the map appears in the atlas of the Provençal pilot Guillaume le Testu. The French ship said to have reached the legendary "Island of Gold" soon after 1527 (*Journal*, vol. xi. p. 82) is at least as likely to have reached a point on the south-west coast of Java as to have discovered Australia. In this case we should suppose that French names had been added to a Portuguese chart by the French pilot.

On the supposition of a reduplication of Java, such as we have hinted at, we might expect to find a repetition of names on the west coast of Java itself, and on that of Jave la Grande, but here again the paucity of names on the former removes the opportunity for effective comparison. Still, it is remarkable that the only two names occurring in Western Java, the R. de St. P° (Pedro?) or Pierre, and Coste P°uro, should have their counterparts in Jave la Grande in the form of C. de St. Drao (or A°‡) and Coste Blanche. It is possible that some clue might be obtained by an examination of the early Portuguese voyages, with a view to explaining the use of the appellative San Pedro, though it is possible that the legend is a corruption of the word "padrao" (pillar), for we are told in Albuquerque's commentaries that the pilot Rodriguez so often alluded to was a man who "knew very well how to set up a memorial monument if it were required" (Hakluyt Soc. Ed., vol. iii. p. 162).

A word or two may be devoted to the islands shown on the French maps in the sea to the north-east of Jave la Grande, which seem to present examples of undoubted Portuguese words. The Yles de Aliofer are evidently named from the word Alojfar (Arabic taken over into Portuguese), "seed-pearl." The next group is named Y° de Tubaros—Isle of Sharks—in the Harleian map, and this is interesting in view of the comparatively early date of this particular map, for in another of the series

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* It has been suggested that the "Baie Bresill" has been derived from the "Brasilie" applied to the supposed southern continent by Orontius Finaeus (1531).

† C on some old maps being hardly distinguishable from L.

‡ The variation in different French maps shows that there is some corruption here.

(the so-called Henri II. map) the name has been translated Y^e^ de Marsouyns (Isle of Porpoises). It is impossible to decide in what relation these islands stand to the other parts of the map. It may be intended either to show their supposed position with respect to Jave la Grande on the one hand, or the archipelago and Pacific ocean * on the other, or merely to indicate that islands whence certain commodities were obtained lay in the seas to the east. It is difficult to find any evidence respecting the application of such names by the Portuguese, and as both seed-pearls and shark's fins are well-known products of the archipelago, the names would apply equally to many islands. An island of Turtles figures in the narratives of the Portuguese historians, and in some modern maps a Turtle island is placed close to Bawean ("Isle of Swine" in Javanese), which would, on one supposition, correspond in position with the Y^e^ de Tubaros. It does not seem impossible that the Portuguese may have mistranslated a native name in this case. A possible explanation of one of the names applied to the third group (Isles de Mayna, or Magaa) is that it is a corruption of the Ilhas das Maçans (Mace islands), by which name Banda was often known. In this case the name Saill applied to the smaller island near it might stand for Ceram, named Seillan in its proper place on the Harleian chart.

In conclusion, it may be observed that, though the divergence in size appears much more serious in the comparison of Jave la Grande with Java than with Australia, the lesser divergence in the latter case is really the more important, as in this the whole argument is based almost solely on considerations of size. In favour of the identification with Java is the fact that this puts no strained construction on the data, but supposes Jave la Grande simply to represent the island so named at the time. In any case, the slight reliance to be placed on the French maps with respect to outlying parts of the world, and the influence still exercised by the old writers, is shown by their delineation of Japan, the insertion of an Isle des Géants in the Southern Indian ocean, and of Catigara on the west coast of South America, as also by the fictitious coast-line of a southern continent with numerous bays and rivers, shown in the later versions. This should surely make us hesitate to base so important assumption as that of a discovery of Australia in the sixteenth century on their unsupported testimony.

OCEANOGRAPHY.†

By Sir JOHN MURRAY, K.C.B., F.R.S., D.SC., LL.D.

In his opening Address to the members of the British Association at the Ipswich meeting, the President cast a retrospective glance at the progress that had taken place in the several branches of scientific inquiry from the time of the formation of the Association in 1831 down to 1895, the year in which were published the last two of the fifty volumes of Reports containing the scientific results of the voyage of H.M.S. *Challenger*. In that very able and detailed review there is no reference whatever to the work of the numerous expeditions which had been fitted out by

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* In this case, the Isle of Sharks would, of course, represent the island of that name touched at by Magellan, and a comparison with other maps on which this is shown would seem to favour this view. The identification of the other groups would, however, be a difficulty.

† Presidential address to the geographical section of the British Association, Dover, September 14, 1899. Map, p. 472.

this and other countries for the exploration of the depths of the sea, nor is there any mention of the great advance in our knowledge of the ocean during the period of sixty-five years then under consideration. This omission may be accounted for by the fact that, at the time of the formation of the British Association, knowledge concerning the ocean was, literally speaking, superficial. The study of marine phenomena had hitherto been almost entirely limited to the surface and shallow waters of the ocean, to the survey of coasts and of oceanic routes directly useful for commercial purposes. Down to that time there had been no systematic attempts to ascertain the physical and biological conditions of those regions of the Earth's surface covered by the deeper waters of the ocean; indeed, most of the apparatus necessary for such investigations had not yet been invented.

The difficulties connected with the exploration of the greater depths of the sea arise principally from the fact that, in the majority of cases, the observations are necessarily indirect. At the surface of the ocean direct observation is possible, but our knowledge of the conditions prevailing in deep water, and of all that is there taking place, is almost wholly dependent on the correct working of instruments, the action of which at the critical moment is hidden from sight.

It was the desire to establish telegraphic communication between Europe and America that gave the first direct impulse to the scientific exploration of the great ocean-basins, and at the present day the survey of new cable routes still yields each year a large amount of accurate knowledge regarding the floor of the ocean. Immediately before the *Challenger* expedition there was a marked improvement in all the apparatus used in marine investigations, and thus during the *Challenger* expedition the great ocean-basins were for the first time systematically and successfully explored. This expedition, which lasted for nearly four years, was successful beyond the expectations of its promoters, and opened out a new era in the study of oceanography. A great many sciences were enriched by a grand accumulation of new facts. Large collections were sent and brought home, and were subsequently described by specialists belonging to almost every civilized nation. Since the *Challenger* expedition there has been almost a revolution in the methods employed in deep-sea observations. The most profound abysses of the ocean are now being everywhere examined by sailors and scientific men with increasing precision, rapidity, and success.

The recognition of oceanography as a distinct branch of science may be said to date from the commencement of the *Challenger* investigations. The fuller knowledge we now possess about all oceanic phenomena has had a great modifying influence on many general conceptions as to the nature and extent of those changes which the crust of the earth is now undergoing and has undergone in past geological times. Our knowledge of the ocean is still very incomplete. So much has, however, already been acquired that the historian will, in all probability, point to the oceanographical discoveries during the past forty years as the most important addition to the natural knowledge of our planet since the great geographical voyages associated with the names of Columbus, Da Gama, and Magellan, at the end of the fifteenth and the beginning of the sixteenth centuries.

It is not my intention on this occasion to attempt anything like a general review of the present state of oceanographic science. But, as nearly all the samples of marine deposits collected during the past thirty years have passed through my hands, I shall endeavour briefly to point out what, in general, their detailed examination teaches with respect to the present condition of the floor of the ocean, and I will thereafter indicate what appears to me to be the bearing of some of these results on speculations as to the evolution of the existing surface features of our planet.

Depth of the Ocean.

All measurements of depth, by which we ascertain the relief of that part of the earth's crust covered by water, are referred to the sea-surface; the measurements of height on the land are likewise referred to sea-level. It is admitted that the ocean has a very complicated undulating surface, in consequence of the attraction which the heterogeneous and elevated portions of the lithosphere exercise on the liquid hydrosphere. In the opinion of geodesists the geoid may in some places depart from the figure of the spheroid by 1000 feet. Still it is not likely that this surface of the geoid departs so widely from the mean ellipsoidal form as to introduce a great error into our estimates of the elevations and depressions on the surface of the lithosphere.

The soundings over the water-surface of the globe have accumulated at a rapid rate during the past fifty years. In the shallow water, where it is necessary to know the depth for purposes of navigation, the soundings may now be spoken of as innumerable; the 100-fathom line surrounding the land can therefore often be drawn in with much exactness. Compared with this shallow-water region, the soundings in deep water beyond the 100-fathom line are much less numerous; each year, however, there are large additions to our knowledge. Within the last decade over ten thousand deep soundings have been taken by British ships alone. The deep soundings are scattered over the different ocean-basins in varying proportions, being now most numerous in the North Atlantic and South-west Pacific, and in these two regions the contour-lines of depth may be drawn in with greater confidence than in the other divisions of the great ocean-basins. It may be pointed out that 659 soundings taken quite recently during cable surveys in the North Atlantic, although much closer together than is usually the case, and yielding much detailed information to cable engineers, have, from a general point of view, necessitated but little alteration in the contour-lines drawn on the *Challenger* bathymetrical maps published in 1895. Again, the recent soundings of the German s.s. *Valdivia* in the Atlantic, Indian, and Southern oceans have not caused very great alteration in the positions of the contour-lines on the *Challenger* maps, if we except one occasion in the South Atlantic when a depth of 2000 fathoms was expected and the sounding machine recorded a depth of only 536 fathoms, and again in the great Southern ocean when depths exceeding 3000 fathoms were obtained in a region where the contour-lines indicated between 1000 and 2000 fathoms. This latter discovery suggests that the great depth recorded by Ross to the south-east of South Georgia may not be very far from the truth.

I have redrawn the several contour-lines of depth in the great ocean-basins, after careful consideration of the most recent data, and these may now be regarded as a somewhat close approximation to the actual state of matters, with the possible exception of the great Southern and Antarctic oceans, where there are relatively few soundings, but where the projected antarctic expeditions should soon be at work. On the whole, it may be said that the general tendency of recent soundings is to extend the area with depths greater than 1000 fathoms, and to show that numerous volcanic cones rise from the general level of the floor of the ocean-basins up to various levels beneath the sea-surface.

The areas marked out by the contour-lines of depth are now estimated as follows:—

Between the shore and			100	fms.,	7,000,000	sq.	geo.	m.	(or 7	per cent. of the sea-bed)
„	100	„	1000	„	10,000,000	„	„		(or 10	„ „ „)
„	1000	„	2000	„	22,000,000	„	„		(or 21	„ „ „)
„	2000	„	3000	„	57,000,000	„	„		(or 55	„ „ „)
Over 3000 fathoms,					7,000,000	„	„		(or 7	„ „ „)
					103,000,000	sq.	geo.	m.	100	per cent.

From these results it appears that considerably more than half of the sea-floor lies at a depth exceeding 2000 fathoms, or over two geographical miles. It is interesting to note that the area within the 100-fathom line occupies 7,000,000 square geographical miles, whereas the area occupied by the next succeeding 900 fathoms (viz. between 100 and 1000 fathoms) occupies only 10,000,000 square geographical miles. This points to a relatively rapid descent of the sea-floor along the continental slopes between 100 and 1000 fathoms, and therefore confirms the results gained by actual soundings in this region, many of which indicate steep inclines or even perpendicular cliffs. Not only are the continental slopes the seat of many deposit-slips and seismic disturbances, but Mr. Benest has given good reasons for believing that underground rivers sometimes enter the sea at depths beyond 100 fathoms, and there bring about sudden changes in deep water. Again, the relatively large area covered by the continental shelf between the shore-line and 100 fathoms points to the wearing away of the land by current and wave action.

On the *Challenger* charts all areas where the depth exceeds 3000 fathoms have been called "deeps," and distinctive names have been conferred upon them. Forty-three such depressions are now known, and the positions of these are shown on the map here exhibited; twenty-four are situated in the Pacific ocean, three in the Indian ocean, fifteen in the Atlantic ocean, and one in the Southern and Antarctic oceans. The area occupied by these thirty-nine deeps is estimated at 7,152,000 square geographical miles, or about 7 per cent. of the total water-surface of the globe. Within these deeps over 250 soundings have been recorded, of which twenty-four exceed 4000 fathoms, including three exceeding 5000 fathoms.

Depths exceeding 4000 fathoms (or 4 geographical miles) have been recorded within eight of the deeps, viz. in the North Atlantic within the Nares deep; in the Antarctic within the Ross deep; in the Banda sea within the Weber deep; in the North Pacific with the Challenger, Tuscarora, and Sapau deeps; and in the South Pacific within the Aldrich and Richards deeps. Depths exceeding 5000 fathoms have been hitherto recorded only within the Aldrich deep of the South Pacific, to the east of the Kermadecs and Friendly islands, where the greatest depth is 5155 fathoms, or 530 feet more than 5 geographical miles, being about 2000 feet more below the level of the sea than the summit of Mount Everest in the Himalayas is above it. The levels on the surface of the lithosphere thus oscillate between the limits of about 10 geographical miles (more than 18 kilometers).

Temperature of the Ocean-floor.

Our knowledge of the temperature on the floor of the ocean is derived from observations in the layers of water immediately above the bottom by means of deep-sea thermometers, from the electric resistance of telegraph cables resting on the bed of the great ocean-basins, and from the temperature of large masses of mud and ooze brought up by the dredge from great depths. These observations are now sufficiently numerous to permit of some general statements as to the distribution of temperature over the bottom of the great oceans.

All the temperatures recorded up to the present time in the sub-surface waters of the open ocean indicate that at a depth of about 100 fathoms seasonal variation of temperature disappears. Beyond that depth there is a constant, or nearly constant, temperature at any one place throughout the year. In some special positions, and under some peculiar conditions, a lateral shifting of large bodies of water takes place on the floor of the ocean at depths greater than 100 fathoms. This phenomenon has been well illustrated by Prof. Libbey off the east coast of North America, where the Gulf stream and Labrador current run side by side in

opposite directions. This lateral shifting cannot, however, be called seasonal, for it appears to be effected by violent storms, or strong off-shore winds bringing up colder water from considerable depths to supply the place of the surface drift, so that the colder water covers stretches of the ocean's bed which under normal conditions are overlaid by warmer strata of water. Sudden changes of temperature like these cause the destruction of innumerable marine animals, and produce very marked peculiarities in the deposits over the areas thus affected.

It is estimated that 92 per cent. of the entire sea-floor has a temperature lower than 40° Fahr. This is in striking contrast to the temperature prevailing at the surface of the ocean, only 16 per cent. of which has a mean temperature under 40° Fahr. The temperature over nearly the whole of the floor of the Indian ocean in deep water is under 35° Fahr. A similar temperature occurs over a large part of the South Atlantic and certain parts of the Pacific, but at the bottom of the North Atlantic basin and over a very large portion of the Pacific the temperature is higher than 35° Fahr. In depths beyond 2000 fathoms, the average temperature over the floor of the North Atlantic is about 2° Fahr., above the average temperature at the bottom of the Indian ocean and South Atlantic, while the average temperature of the bed of the Pacific is intermediate between these.

It is admitted that the low temperature of the deep sea has been acquired at the surface in polar and sub-polar regions, chiefly within the higher latitudes of the southern hemisphere, where the cooled surface water sinks to the bottom and spreads slowly over the floor of the ocean into equatorial regions. These cold waters carry with them into the deep sea the gases of the atmosphere, which are everywhere taken up at the surface according to the known laws of gas absorption. In this way myriads of living animals are enabled to carry on their existence at all depths in the open ocean. The nitrogen remains more or less constant at all times and places, but the proportion of oxygen is frequently much reduced in deep water, owing to the processes of oxidation and respiration which are there going on.

The deep sea is a region of darkness as well as of low temperature, for the direct rays of the sun are wholly absorbed in passing through the superficial layers of water. Plant-life is in consequence quite absent over 93 per cent. of the bottom of the ocean, or 66 per cent. of the whole surface of the lithosphere. The abundant deep-sea fauna, which covers the floor of the ocean, is therefore ultimately dependent for food upon organic matter assimilated by plants near its surface, in the shallower waters near the coast-lines, and on the surface of the dry land itself.

As has been already stated, about 7,000,000 square geographical miles of the sea-floor lies within the 100-fathom line, and this area is in consequence subject to seasonal variations of temperature, to strong currents, to the effects of sunlight, and presents a great variety of physical conditions. The planktonic plant-life is here reinforced by the littoral seaweeds, and animal life is very abundant. About 40 per cent. of the water over the bottom of this shallow-water area has a mean temperature under 40° Fahr., while 20 per cent. has a mean temperature between 40° and 60° Fahr., and 40 per cent. a temperature of over 60° Fahr.

It follows from this that only 3 per cent. of the floor of the ocean presents conditions of temperature favourable for the vigorous growth of corals and those other benthonic organisms which make up coral reefs and require a temperature of over 60° Fahr. all the year round. On the other hand, more than half of the surface of the ocean has a temperature which never falls below 60° Fahr. at any time of the year. In these surface-waters with a high temperature the shells of pelagic molluscs, foraminifera, algæ, and other planktonic organisms, are secreted in great abundance, and fall to the bottom after death.

It thus happens that, at the present time, over nearly the whole floor of the ocean we have mingled in the deposits the remains of organisms which had lived under widely different physical conditions, since the remains of organisms which lived in tropical sunlight, and in water at a temperature above 80° Fahr., all their lives, now lie buried in the same deposit on the sea-floor together with the remains of other organisms which lived all their lives in darkness and at a temperature near to the freezing-point of fresh water.

Marine Deposits on the Ocean-floor.

The marine deposits now forming over the floor of the ocean present many interesting peculiarities according to their geographical and bathymetrical position. On the continental shelf, within the 100-fathom line, sands and gravels predominate, while on the continental slopes beyond the 100-fathom line, blue muds, green muds, and red muds, together with volcanic muds and coral muds, prevail, the two latter kinds of deposits being, however, more characteristic of the shallow water around oceanic islands. The composition of all these terrigenous deposits depends on the structure of the adjoining land. Around continental shores, except where coral reefs, limestones, and volcanic rocks are present, the materials consist principally of fragments and minerals derived from the disintegration of the ancient rocks of the continents, the most characteristic and abundant mineral species being quartz. River detritus extends in many instances far from the land, while off high and bold coasts, where no large rivers enter the sea, pelagic conditions may be found in somewhat close proximity to the shore-line. It is in these latter positions that green muds containing much glauconite, and other deposits containing many phosphatic nodules, have for the most part been found; as, for instance, off the eastern coast of the United States, off the Cape of Good Hope, and off the eastern coasts of Australia and Japan. The presence of glauconitic grains and phosphatic nodules in the deposit at these places appears to be very intimately associated with a great annual range of temperature in the surface and shallow waters, and the consequent destruction of myriads of marine animals. As an example of this phenomenon may be mentioned the destruction of the tile-fish in the spring of 1882 off the eastern coast of North America, when a layer, 6 feet in thickness, of dead fish and other marine animals, was believed to cover the ocean-floor for many square miles.

In all the terrigenous deposits the evidences of the mechanical action of tides, of currents, and of a great variety of physical conditions, may almost everywhere be detected, and it is possible to recognize in these deposits an accumulation of materials analogous to many of the marine stratified rocks of the continents, such as sandstones, quartzites, shales, marls, greensands, chalks, limestones, conglomerates, and volcanic grits.

With increasing depth and distance from the continents the deposits gradually lose their terrigenous character, the particles derived directly from the emerged land decrease in size and in number, the evidences of mechanical action disappear, and the deposits pass slowly into what have been called pelagic deposits at an average distance of about 200 miles from continental coast-lines. The materials composing pelagic deposits are not directly derived from the disintegration of the continents and other land-surfaces. They are largely made up of the shells and skeletons of marine organisms secreted in the surface waters of the ocean, consisting either of carbonate of lime, such as pelagic molluscs, pelagic foraminifera, and pelagic algæ, or of silica, such as diatoms and radiolarians. The inorganic constituents of the pelagic deposits are for the most part derived from the attrition of floating pumice, from the disintegration of water-logged pumice, from showers of

volcanic ashes, and from the *débris* ejected from submarine volcanoes, together with the products of their decomposition. Quartz particles, which play so important a *rôle* in the terrigenous deposits, are almost wholly absent, except where the surface waters of the ocean are affected by floating ice, or where the prevailing winds have driven the desert sands far into the oceanic areas. Glauconite is likewise absent from these abysmal regions. The various kinds of pelagic deposits are named according to their characteristic constituents, pteropod oozes, globigerina oozes, diatom oozes, radiolarian oozes, and red clay.

The distribution of the deep-sea deposits over the floor of the ocean is shown on the map here exhibited, but it must be remembered that there is no sharp line of demarcation between them; the terrigenous pass gradually into the pelagic deposits, and the varieties of each of these great divisions also pass insensibly the one into the other, so that it is often difficult to fix the name of a given sample.

On another map here exhibited the percentage distribution of carbonate of lime in the deposits over the floor of the ocean has been represented, the results being founded on an extremely large number of analyses. The results are also shown in the following table:—

	Sq. geo. miles.	Percentage.
Over 75 per cent. $CaCO_3$	6,000,000	5·8
50 to 75 „ „	24,000,000	23·2
25 to 50 „ „	14,000,000	13·5
Under 25 „ „	59,000,000	57·5
	103,000,000	100

The carbonate of lime shells derived from the surface play a great and puzzling *rôle* in all deep-sea deposits, varying in abundance according to the depth of the ocean and the temperature of the surface waters. In tropical regions removed from land, where the depths are less than 600 fathoms, the carbonate of lime due to the remains of these organisms from the surface may rise to 80 or 90 per cent.; with increase of depth, and under the same surface conditions, the percentage of carbonate of lime slowly diminishes, till, at depths of about 2000 fathoms, the average percentage falls to about 60, at 2400 fathoms to about 30, and at about 2600 fathoms to about 10, beyond which depth there may be only traces of carbonate of lime due to the presence of surface shells. The thin and more delicate surface shells first disappear from the deposits, the thicker and denser ones alone persist to greater depths. A careful examination of a large number of observations shows that the percentage of carbonate of lime in the deposits falls off much more rapidly at depths between 2200 and 2500 fathoms than at other depths.

The red clay, which occurs in all the deeper stretches of the ocean far from land, and covers nearly half of the whole sea-floor, contains—in addition to volcanic *débris*, clayey matter, the oxides of iron and manganese—numerous remains of whales, sharks, and other fishes, together with zeolitic crystals, manganese nodules, and minute magnetic spherules, which are believed to have a cosmic origin. One haul of a small trawl in the Central Pacific brought to the surface on one occasion, from a depth of about 2½ miles, many bushels of manganese nodules, along with fifteen hundred sharks' teeth, over fifty fragments of earbones and other bones of whales. Some of these organic remains, such as the *Carcharodon* and *Lamna* teeth and the bones of the ziphioid whales, belong apparently to extinct species. One or two of these sharks' teeth, earbones, or cosmic spherules, may be occasionally found in a globigerina ooze, but their occurrence in this or any deposits other than red clay is extremely rare.

Our knowledge of the marine deposits is limited to the superficial layers; as a rule the sounding-tube does not penetrate more than 6 or 8 inches, but in some positions the sounding-tube and dredge have been known to sink fully 2 feet into the deposit. Sometimes a red clay is overlaid by a globigerina ooze, more frequently a red clay overlies a globigerina ooze, the transition between the two layers being either abrupt or gradual. In some positions it is possible to account for these layers by referring them to changes in the condition of the surface waters, but in other situations it seems necessary to call in elevations and subsidences of the sea-floor.

If the whole of the carbonate of lime shells be removed by dilute acid from a typical sample of globigerina ooze, the inorganic residue left behind is quite similar in composition to a typical red clay. This suggests that possibly, owing to some hypogene action, such as the escape of carbonic acid through the sea-floor, a deposit that once was a globigerina ooze might be slowly converted into a red clay. However, this is not the interpretation which commends itself after an examination of all the data at present available; a consideration of the rate of accumulation probably affords a more correct interpretation. It appears certain that the terrigenous deposits accumulate much more rapidly than the pelagic deposits. Among the pelagic deposits the pteropod and globigerina oozes of the tropical regions, being made up of the calcareous shells of a much larger number of tropical species, apparently accumulate at a greater rate than the globigerina oozes in extra-tropical areas. Diatom ooze being composed of both calcareous and siliceous organisms has again a more rapid rate of deposition than radiolarian ooze. In red clay the minimum rate of accumulation takes place. The number of sharks' teeth, of ear-bones and other bones of cetaceans, and of cosmic spherules, in a deposit may indeed be taken as a measure of the rate of deposition. These spherules, teeth, and bones are probably more abundant in the red clays, because few other substances there fall to the bottom to cover them up, and they thus form an appreciable part of the whole deposit. The volcanic materials in a red clay having, because of the slow accumulation, been for a long time exposed to the action of sea-water, have been profoundly altered. The massive manganese-iron nodules and zeolitic crystals present in the deposit are secondary products arising from the decomposition of these volcanic materials, just as the formation of glauconite, phosphatic, and calcareous and barytic nodules accompanies the decomposition of terrigenous rocks and minerals in deposits nearer continental shores. There is thus a striking difference between the average chemical and mineralogical composition of terrigenous and pelagic deposits.

It would be extremely interesting to have a detailed examination of one of those deep holes where a typical red clay is present, and even to bore some depth into such a deposit if possible, for in these positions it is probable that not more than a few feet of deposit have accumulated since the close of the Tertiary period. One such area lies to the south-west of Australia, and its examination might possibly form part of the programme of the approaching Antarctic explorations.

Life on the Ocean-floor.

It has already been stated that plant-life is limited to the shallow waters, but fishes and members of all the invertebrate groups are distributed over the floor of the ocean at all depths. The majority of these deep-sea animals live by eating the mud, clay, or ooze, or by catching the minute particles of organic matter which fall from the surface. It is probably not far from the truth to say that three-fourths of the deposits now covering the floor of the ocean have passed through the alimentary canals of marine animals. These mud-eating species, many

of which are of gigantic size when compared with their allies living in the shallow coastal waters, become in turn the prey of numerous rapacious animals armed with peculiar prehensible and tactile organs. Some fishes are blind, while others have very large eyes. Phosphorescent light plays a most important *rôle* in the deep sea, and is correlated with the prevailing red and brown colours of deep-sea organisms. Phosphorescent organs appear sometimes to act as a bull's-eye lantern to enable particles of food to be picked up, and at other times as a lure or a warning. All these peculiar adaptations indicate that the struggle for life may be not much less severe in the deep sea than in the shallower waters of the ocean.

Many deep-sea animals present archaic characters; still the deep sea cannot be said to contain more remnants of faunas which flourished in remote geological periods than the shallow and fresh waters of the continents. Indeed, king-crabs, lingulas, trigonias, Port Jackson sharks, *ceratodus*, *lepidosiren*, and *protopterus*, probably represent older faunas than anything to be found in the deep sea.

Sir Wyville Thomson was of opinion that, from the Silurian period to the present day, there had been as now a continuous deep ocean with a bottom temperature oscillating about the freezing-point of fresh water, and that there had always been an abyssal fauna. I incline to the view that in palæozoic times the ocean-basins were not so deep as they are now; that the ocean then had throughout a nearly uniform high temperature, and that life was either absent or represented only by bacteria and other low forms in great depths, as is now the case in the Black sea, where life is practically absent beyond 100 fathoms, and where the deeper waters are saturated with sulphuretted hydrogen. This is not, however, the place to enter on speculations concerning the origin of the deep-sea fauna, nor to dwell on what has been called "bipolarity" in the distribution of marine organisms.

Evolution of the Continental and Oceanic Areas.

I have now pointed out what appears to me to be some of the more general results arrived at in recent years regarding the present condition of the floor of the ocean. I may now be permitted to indicate the possible bearing of these results on opinions as to the origin of some fundamental geographical phenomena; for instance, on the evolution of the protruding continents and sunken ocean-basins. In dealing with such a problem much that is hypothetical must necessarily be introduced, but these speculations are based on ascertained scientific facts.

The well-known American geologist, Dutton, says: "It has been much the habit of geologists to attempt to explain the progressive elevation of plateaus and mountain platforms, and also the folding of strata, by one and the same process. I hold the two processes to be distinct, and having no necessary relation to each other. There are plicated regions which are little or not at all elevated, and there are elevated regions which are not plicated." Speaking of great regional uplifts, he says further: "What the real nature of the uplifting force may be is, to my mind, an entire mystery, but I think we may discern at least one of its attributes, and that is a gradual expansion or a diminution of density of the subterranean magmas. . . . We know of no cause which could either add to the mass or diminish the density, yet one of the two must surely have happened. . . . Hence I infer that the cause which elevates the land involves an expansion of the underlying magmas, and the cause which depresses it is a shrinkage of the magmas; the nature of the process is at present a complete mystery." I shall endeavour to show how the detailed study of marine deposits may help to solve the mystery here referred to by Dutton.

The surface of the globe has not always been as we now see it. When, in the

past, the surface had a temperature of about 400° Fahr., what is now the water of the ocean must have existed as water-vapour in the atmosphere, which would thereby—as well as because of the presence of other substances—be increased in density and volume. Life, as we know it, could not then exist. Again, science foresees a time when low temperatures, like those produced by Prof. Dewar at the Royal Institution, will prevail over the face of the earth. The hydrosphere and atmosphere will then have disappeared within the rocky crust, or the waters of the ocean will have become solid rock, and over their surface will roll an ocean of liquid air about 40 feet in depth. Life, as we know it, unless it undergoes suitable secular modifications, will be extinct. Somewhere between these two indefinite points of time in the evolution of our planet it is our privilege to live, to investigate, and to speculate concerning the antecedent and future conditions of things.

When we regard our globe with the mind's eye, it appears at the present time to be formed of concentric spheres, very like, and still very unlike, the successive coats of an onion. Within is situated the vast nucleus or *centrosphere*; surrounding this is what may be called the *tektosphere*,* a shell of materials in a state bordering on fusion, upon which rests and creeps the *lithosphere*. Then follow *hydrosphere* and *atmosphere*, with the included *biosphere*.† To the interaction of these six geospheres, through energy derived from internal and external sources, may be referred all the existing superficial phenomena of the planet.

The vast interior of the planetary mass, although not under direct observation, is known, from the results of the astronomer and physicist, to have a mean density of 5·6, or twice that of ordinary surface rock. The substances brought within the reach of observation in veinstones, in lavas, and hypogene rocks—by the action of water as a solvent and sublimant—warrant the belief that the centrosphere is largely made up of metals and metalloids with imprisoned gases. It is admitted that the vast nucleus has a very high temperature, but so enormous is the pressure of the super-incumbent crust that the melting-point of the substances in the interior is believed to be raised to a higher value than the temperature there existing—the centrosphere in consequence remains solid, for it may be assumed that the melting-point of rock-forming materials is raised by increase of pressure. Astronomers from a study of precession and nutation have long been convinced that the centrosphere must be practically solid.

Recent seismological observations indicate the transmission of two types of waves through the earth—the condensational-rarefactional and the purely distortional—and the study of these tremors supports the view that the centrosphere is not only solid, but possesses great uniformity of structure. The seismological investigations of Profs. Milne and Knott point also to a fairly abrupt boundary or transition surface, where the solid nucleus passes into the somewhat plastic magma on which the firm upper crust rests.

In this plastic layer or shell—named the *tektosphere*—the materials are most probably in a state of unstable equilibrium and bordering on fusion. Here the loose-textured solids of the external crust are converted into the denser solids of the nucleus or into molten masses, at a critical point of temperature and pressure; deep-seated rocks may in consequence escape through fissures in the lithosphere. Within the lithosphere itself the temperature falls off so rapidly towards the surface as to be everywhere below the melting-point of any substance there under its particular pressure.

Now, as the solid centrosphere slowly contracted from loss of heat, the primitive

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* τηκτός, molten. † βίος, life.

lithosphere, in accommodating itself—through changes in the tektosphere—to the shrinking nucleus, would be buckled, warped, and thrown into ridges. That these movements are still going on is shown by the fact that the lithosphere is everywhere and at all times in a slight but measurable state of pulsation. The rigidity of the primitive rocky crust would permit of considerable deformations of the kind here indicated. Indeed, the compression of mountain chains has most probably been brought about in this manner, but the same cannot be said of the elevation of plateaus, of mountain platforms, and of continents.

From many lines of investigation it is concluded, as we have seen, that the centrosphere is homogeneous in structure. Direct observation, on the other hand, shows that the lithosphere is heterogeneous in composition. How has this heterogeneity been brought about? The original crust was almost certainly composed of complex and stable silicates, all the silicon dioxide being in combination with bases. Lord Kelvin has pointed out that, when the solid crust began to form, it would rapidly cool over its whole surface; the precipitation of water would accelerate this process, and there would soon be an approximation to present conditions. As time went on the plastic or critical layer—the tektosphere—immediately beneath the crust would gradually sink deeper and deeper, while ruptures and re-adjustments would become less and less frequent than in earlier stages. With the first fall of rain the silicates of the crust would be attacked by water and carbon dioxide, which can at low temperatures displace silicon dioxide from its combinations. The silicates, in consequence, have been continuously robbed of a part, or the whole, of their bases. The silica thus set free goes ultimately to form quartz veins and quartz sand on or about the emerged land, while the bases leached out of the disintegrating rocks are carried out into the ocean and ocean-basins. A continuous disintegration and differentiation of materials of the lithosphere, accompanied by a sort of migration and selection among mineral substances, is thus always in progress. Through the agency of life, carbonate of lime accumulates in one place; through the agency of winds, quartz sand is heaped up in another; through the agency of water, beds of clay, of oxides of iron and of manganese are spread out in other directions.

The contraction of the centrosphere supplies the force which folds and crumples the lithosphere. The combined effect of hydrosphere, atmosphere, and biosphere on the lithosphere gives direction and a determinate mode of action to that force. From the earliest geological times the most resistant dust of the continents has been strewn along the marginal belt of the sea-floor skirting the land. At the present time the deposits over this area contain on the average about 70 per cent. of free and combined silica, mostly in the form of quartz sand. In the abysmal deposits far from land there is an average of only about 30 per cent. of silica, and hardly any of this in the form of quartz sand. Lime, iron, and the other bases largely predominate in these abysmal regions. The continuous loading on the margins of the emerged land by deposits tends by increased pressure to keep the materials of the tektosphere in a solid condition immediately beneath the loaded area. The unloading of emerged land tends by relief of pressure to produce a viscous condition of the tektosphere immediately beneath the denuded surfaces. Under the influence of the continuous shakings, tremors, and tremblings always taking place in the lithosphere the materials of the tektosphere yield to the stresses acting on them, and the deep-seated portions of the terrigenous deposits are slowly carried towards, over, or underneath the emerged land. The rocks subsequently re-formed beneath continental areas out of these terrigenous materials, under great pressure and in hydrothermal conditions, would be more acid than the rocks from which they were originally derived, and it is well known that the acid silicates

have a lower specific gravity than the intermediate or basic ones. By a continual repetition of this process the continental protuberances have been gradually built up of lighter materials than the other parts of the lithosphere. The relatively light quartz, which is also the most refractory, the most stable, and the least fusible among rock-forming minerals, plays in all this the principal *rôle*. The average height of the surface of the continents is about 3 miles above the average level of the abysmal regions. If now we assume the average density of the crust beneath the continents to be 2·5, and of the part beneath the abysmal regions to be 3, then the spheroidal surface of equal pressure—the tektosphere—would have a minimum depth of 18 miles beneath the continents and 15 miles beneath the oceans, or if we assume the density of the crust beneath the continents to be 2·5, and beneath the abysmal regions to be 2·8, then the tektosphere would be 28 miles beneath the continents and 25 miles beneath the oceans. The present condition of the Earth's crust might be brought about by the disintegration of a quantity of quartz-free volcanic rock, covering the continental areas to a depth of 18 miles, and the re-formation of rocks out of the disintegrated materials.

Where the lighter and more bulky substances have accumulated there has been a relative increase of volume, and in consequence bulging has taken place at the surface over the continental areas. Where the denser materials have been laid down there has been flattening, and in consequence a depression of the abysmal regions of the ocean-basins. It is known that, as a general rule, where large masses of sediment have been deposited, their deposition has been accompanied by a depression of the area. On the other hand, where broad mountain platforms have been subjected to extensive erosion, the loss of altitude by denudation has been made good by a rise of the platform. This points to a movement of matter on to the continental areas.

If this be anything like a true conception of the interactions that are taking place between the various geospheres of which our globe is made up, then we can understand why, in the gradual evolution of the surface features, the average level of the continental plains now stands permanently about 3 miles above the average level of those plains which form the floor of the deep ocean-basins. We may also understand how the defect of mass under the continents and an excess of mass under the oceans have been brought about, as well as deficiency of mass under mountains and excess of mass under plains. Even the local anomalies indicated by the plumb-line, gravity, and magnetic observations may in this way receive a rational explanation. It has been urged that an enormous time—greater even than what is demanded by Darwin—would be necessary for an evolution of the existing surface features on these lines. I do not think so. Indeed, in all that relates to geological time I agree, generally speaking, with the physicists rather than with the biologists and geologists.

Progress of Oceanic Research.

I have now touched on some of the problems and speculations suggested by recent deep-sea explorations; and there are many others, equally attractive, to which no reference has been made. It is abundantly evident that, for the satisfactory explanation of many marine phenomena, further observations and explorations are necessary. Happily there is no sign that the interest in oceanographical work has in any way slackened. On the contrary, the number of scientific men and ships engaged in the study of the ocean is rapidly increasing. Among all civilized peoples and in all quarters of the globe the economic importance of many of the problems that await solution is clearly recognized.

We have every reason to be proud of the work continually carried on by the officers and ships attached to the Hydrographic Department of the British Navy.

They have surveyed coasts in all parts of the world for the purposes of navigation, and within the past few years have greatly enlarged our knowledge of the sea-bed and deeper waters over wide stretches of the Pacific and other oceans. The samples of the bottom which are procured, being always carefully preserved by the officers, have enabled very definite notions to be formed as to the geographical and bathymetrical distribution of marine deposits.

The ships belonging to the various British Telegraph Cable Companies have done most excellent work in this as well as in other directions. Even during the present year Mr. R. E. Peake has in the s.s. *Britannia* procured 477 deep soundings in the North Atlantic, besides a large collection of deep-sea deposits, and many deep-sea temperature and current observations.

The French have been extending the valuable work of the *Talisman* and *Travailleur*, while the Prince of Monaco is at the present moment carrying on his oceanic investigations in the arctic seas with a large new yacht elaborately and specially fitted out for such work. The Russians have recently been engaged in the scientific exploration of the Black sea and the Caspian sea, and a special ship is now employed in the investigation of the arctic fisheries of the Murman coast under the direction of Prof. Knipowitsch. Admiral Makaroff has this summer been hammering his way through arctic ice, and at the same time carrying on a great variety of systematic observations and experiments on board the *Yermak*—the most powerful and most effective instrument of marine research ever constructed. Mr. Alexander Agassiz has this year recommenced his deep-sea explorations in the Pacific on board the U.S. steamer *Albatross*. He proposes to cross the Pacific in several directions, and to conduct investigations among the Paumotu and other coral island groups. Prof. Weber is similarly employed on board a Dutch man-of-war in the East Indian seas. The Deutsche Seewarte at Hamburg, under the direction of Dr. Neumayer, continues its praiseworthy assistance and encouragement to all investigators of the ocean, and this year the important German Deep-sea Expedition, in the s.s. *Valdivia*, arrived home after most successful oceanographical explorations in the Atlantic, Indian, and Great Southern oceans.

The *Belgica* has returned to Europe safely with a wealth of geological and biological collections and physical observations, after spending, for the first time on record, a whole winter among the icefields and icebergs of the antarctic. Mr. Borchgrevink in December last again penetrated to Cape Adare, successfully landed his party at that point, and is now wintering on the antarctic continent. The expeditions of Lieut. Peary, of Prof. Nathorst, of Captain Sverdrup, and of the Duke of Abruzzi, which are now in progress, may be expected to yield much new information about the condition of the Arctic ocean. Mr. Wellman has just returned from the north of Franz Josef land, with observations of considerable interest.

Some of the scientific results obtained by the expeditions in the Danish steamer *Ingolf* have lately been published, and these, along with the results of the joint work pursued for many years by the Swedes, Danes, and Norwegians, may ultimately have great economic value from their direct bearing on fishery problems, and on weather forecasting over long periods of time.

Largely through the influence of Prof. Otto Pettersson an International Conference assembled at Stockholm a few months ago, for the purpose of deliberating as to a programme of conjoint scientific work in the North sea and northern parts of the Atlantic, with special reference to the economic aspect of sea-fisheries. A programme was successfully drawn up, and an organization suggested for carrying it into effect; these proposals are now under the consideration of the several States. The Norwegian Government has voted a large sum of money for building a special vessel to conduct marine investigations of the nature recommended by this

conference. It is to be hoped the other North sea powers may soon follow this excellent example.

The various marine stations and laboratories for scientific research in all parts of the world furnish each year much new knowledge concerning the ocean. Among our own people the excellent work carried on by the Marine Biological Association, the Irish Fisheries Department, the Scottish Fishery Board, the Lancashire Fisheries Committee, the Cape and Canadian Fisheries Departments, is well worthy of recognition and continued support. Mr. George Murray, Mr. H. N. Dickson, Prof. Cleve, Prof. Otto Pettersson, Mr. Robert Irvine, and others have, with the assistance of the officers of the Mercantile Marine, accumulated in recent years a vast amount of information regarding the distribution of temperature and salinity, as well as of the planktonic organisms at the surface of the ocean. The papers by Mr. H. C. Russell on the icebergs and currents of the Great Southern ocean, and of Mr. F. W. Walker on the density of the water in the Southern Hemisphere, show that the Australian colonies are taking a practical interest in oceanographical problems.

Proposed Antarctic Explorations.

The great event of the year, from a geographical point of view, is the progress that has been made towards the realization of a scheme for the thorough scientific exploration in the near future of the whole South Polar region. The British and German Governments have voted or guaranteed large sums of money to assist in promoting this object, and princely donations have likewise been received from private individuals, in this connection the action of Mr. L. W. Longstaff in making a gift of £25,000, and of Mr. A. C. Harmsworth in promising £5000, being beyond all praise.

There is an earnest desire among the scientific men of Britain and Germany that there should be some sort of co-operation with regard to the scientific work of the two expeditions, and that these should both sail in 1901, so that the invaluable gain attaching to simultaneous observations may be secured. Beyond this nothing has, as yet, been definitely settled. The members of the Association will presently have an opportunity of expressing their opinions as to what should be attempted by the British Expedition, how the work in connection with it should be arranged, and how the various researches in view can best be carried to a successful issue.

I have long taken a deep interest in antarctic exploration, because such exploration must necessarily deal largely with oceanographical problems, and also because I have had the privilege of studying the conditions of the ocean within both the arctic and antarctic circles. In the year 1886 I published an article on the subject of Antarctic Exploration in the *Scottish Geographical Magazine*. This article led to an interesting interview, especially when viewed in the light of after events, for, a few weeks after it appeared in type, a young Norwegian walked into the *Challenger* office in Edinburgh to ask when the proposed expedition would probably start, and if there were any chance of his services being accepted. His name was Nansen.

When at the request of the President I addressed the Royal Geographical Society on the same subject in the year 1893, I made the following statement as to what it seemed to me should be the general character of the proposed exploration: "A dash at the South Pole is not, however, what I advocate, nor do I believe *that* is what British science at the present time desires. It demands rather a steady, continuous, laborious, and systematic exploration of the whole southern region with all the appliances of the modern investigator." At the same time I urged further, that these explorations should be undertaken by the Royal

Navy in two ships, and that the work should extend over two winters and three summers.

This scheme must now be abandoned, so far at least as the Royal Navy is concerned, for the Government has intimated that it can spare neither ships nor officers, men nor money, for an undertaking of such magnitude. The example of foreign powers—rather than the representations from our own scientific men—appears to have been chiefly instrumental in at last inducing the Government to promise a sum of £45,000, provided that an equal amount be forthcoming from other sources. This resolve throws the responsibility for the financial administration, for the equipment, and for the management of this exploration, on the representative scientific societies, which have no organization ready for carrying out important executive work on such an extensive scale. I am doubtful whether this state of matters should be regarded as a sign of increasing lukewarmness on the part of the Government towards marine research, or should rather be looked on as a most unexpected and welcome recognition of the growing importance of science and scientific men to the affairs of the nation. Let us adopt the latter view, and accept the heavy responsibility attached thereto.

Any one who will take the trouble to read, in the *Proceedings* of the Royal Society of London, the account of the discussion which recently took place on "The Scientific Advantages of an Antarctic Expedition," will gather some idea of the number and wide range of the subjects which it is urged should be investigated within the antarctic area; the proposed researches have to do with almost every branch of science. Unless an earnest attempt be made to approach very near to the ideal there sketched out, widespread and lasting disappointment will certainly be felt among the scientific men of this country. The proposed expedition should not be one of adventure. Not a rapid invasion and a sudden retreat, with tales of hardships and risks, but a scientific occupation of the unknown area by observation and experiment should be aimed at in these days.

I have all along estimated the cost of a well-equipped antarctic expedition at about £150,000. I see no reason for changing my views on this point at the present time, nor on the general scope of the work to be undertaken by the proposed expedition, as set forth in the papers I have published on the subject. There is now a sum of at most £90,000 in hand, or in view. If one ship should be specially built for penetrating the icy region, and be sent south with one naturalist on board, then such an expedition may, it will be granted, bring back interesting and important results. But it must be distinctly understood that this is not the kind of exploration scientific men have been urging on the British public for the past fifteen or twenty years. We must, if possible, have two ships, with landing parties for stations on shore, and with a recognized scientific leader and staff on board of each ship. Although we cannot have the Royal Navy, these ships can be most efficiently officered and manned from the Mercantile Marine. With only one ship many of the proposed observations would have to be cut out of the programme. In anticipation of this being the case, there are at the present moment irreconcilable differences of opinion among those most interested in these explorations, as to which sciences must be sacrificed.

The difficulties which at present surround this undertaking are fundamentally those of money. These difficulties would at once disappear, and others would certainly be overcome, should the members of the British Association at this meeting agree to place in the hands of their president a sum of £50,000, so that the total amount available for antarctic exploration would become something like £150,000. Although there is but one central Government, surely there are within the bounds of this great empire two more men like Mr. Longstaff. The Government

has suddenly placed the burden of upholding the high traditions of Great Britain in marine research and exploration on the shoulders of her scientific men. In their name I appeal to all our well-to-do fellow-countrymen in every walk of life for assistance, so that these new duties may be discharged in a manner worthy of the empire and of the well-earned reputation of British science.

THE MONTHLY RECORD.

EUROPE.

Proposed New Map of France.—An agitation has lately been set on foot in France for the execution of a new map of that country on the scale of 1 : 10,000. The question has been discussed, under the auspices of the *Service Géographique de l'Armée*, by Colonel Berthaut, while the Paris Academy of Sciences has also interested itself in the matter. The *Comptes Rendus* of that body for June 26 last contains the report, presented by M. de Lapparent, of the committee appointed to consider the question. It is now eighty-two years, the report states, since the resolution was taken to prepare a map of France "meeting all the requirements of the public services," but obstacles of all kinds have prevented the realization of the project. The existing military map, however excellent, is quite inadequate to meet the various demands of the nation in connection with public works of all kinds, for which special surveys are again and again necessary. No smaller scale than that proposed (1 : 10,000) would enable all the details of the topography to be inserted in their true proportion, and science especially suffers from the insufficiency of the existing map. Geology in particular demands a map on which all details of surface and relief, however complicated, can be clearly shown, and the same need is felt in the case of agricultural science. Lastly, it is pointed out that the newly arisen science of physical geography has everything to gain from the possession of a good map, by means of which the various forms of surface can be properly analyzed and their history elucidated; while the present seems a particularly propitious time for undertaking the work, owing to the existence of a suitable agency in the *Service Géographique de l'Armée*. The conclusions of the report having been adopted, a deputation from the Academy waited on the Minister of War, who expressed his sympathy with the project.

Bathymetrical Observations in the Italian Lakes.—We learn from the June number of the *Bollettino* of the Italian Geographical Society, that a bathymetrical survey of the lakes of Como, Mezzola, Garlate, and Olginate has lately been carried out by Dr. G. de Agostini. The result of a large number of soundings in the Lake of Como was to give the maximum depth as 410 metres (1345 feet), at a point nearly a mile south of the *Punta della Cavagnola*, and a quarter of a mile from the shore opposite the village of Nesso. This depth compares with a maximum of 1220 feet in the case of Lake Maggiore, 1134 feet for the Lake of Garda, 944 feet for that of Lugano, and 820 for that of Iseo, so that the Lake of Como is the deepest of the Italian lakes, and is only surpassed in Europe by those of Hornisdalsvand (1593 feet) and Mjösen (1476 feet), in Norway. The abysmal temperature of Como was found to be 6° C. (42°·8 Fahr.). The maximum depths of the three small lakes of Mezzola, Garlate, and Olginate are, respectively, 226, 111, and 57 feet, and the corresponding bottom temperatures 43°·3, 47°·6, and 48° Fahr.

Mr. Howell's Journey across the Láng Jökull, Iceland.—Mr. F. W. W. Howell writes to us from the west coast of Iceland, under date August 23, announcing that the first crossing of the Láng Jökull was successfully accomplished by his

party on the 2nd, 3rd, and 4th of the month. Accompanied by Messrs. Stoughton-Holborn and Barrett, both of Merton College, Oxford, and by two Icelanders, Jónas and Erlendur of Reykjavik, Mr. Howell left Kalmanstunga on August 1, and early the following day reached Flosaskart, between Eroeks Jökull and Láng Jökull. Here two sledges were put together and packed, and, with the help of a pony for part of the distance, were dragged up the ice towards the summit ridge, where camp was pitched at an altitude of 5000 feet. The night was superb, peaks rising on all sides like islands from an ocean of cloud beneath. The direction so far had been south-east, but the next morning a start was made north-east, the crest of the Jökull being followed all day, and camp again pitched on the ice near a small tufa peak north of Hvítárvatn. This was surrounded on all sides but the north-north east by a deep ice-moat, with almost perpendicular walls, the inner ones being the tufa cliffs of the hill. During the day the views extended from Snæfells Jökull to Vatna Jökull, 100 miles each way. On the 4th the travellers passed through a portal of twin rocks, and descended to a sea of ice north of Hvítafell, which is joined by a narrow ridge to Láng Jökull. The glacier was left at Fagrahlið, the passage off it being, owing to crevasses and the abrupt slope, the only part of the journey which involved serious difficulty.

ASIA.

Final Results of the Dutreuil de Rhins Mission in Central Asia.*—The third volume of M. Grenard's important work on the results of his journey with M. de Rhins in Central Asia, consists of various memoirs on historical and archæological questions, and—most important of all from a geographical point of view—a clear summary of the principal physical facts relating to the countries visited by the expedition. Although the author regrets that the death of M. de Rhins has made it impossible to present such an accurate sketch of the physical geography of the region as might otherwise have been the case, the publication of the work, and especially of the excellent atlas of maps which accompanies it, certainly marks an important advance in our knowledge of Central Asian geography. M. Grenard devotes special attention to the orography of the vast region south of Turkestan, stretching from Leh to Sining and from Khotan to Lhasa, and although much detail remains to be filled in, he considers that we now possess a good general idea of the main facts of the subject. He describes in turn the Altyn (or Astyn) Tagh, the great northern range which extends from the Pamirs to the Chinese province of Honan; the Ustun or Arka Tagh, which may be regarded as a continuation of the Karakoram; and a series of seven less-known chains south of the Ustun Tagh, which seem to have a general east-and-west direction, and of which the last runs south of Lake Tengri Nor. From a hydrographical point of view this last plays an analogous part with the Ustun Tag, as the two chains form the north and south limits of the assemblage of small lacustrine basins which lies between them. In the same way the Altyn Tagh is to be regarded as the counterpart of the Himalaya. The two interior chains are, properly speaking, the highest in Central Asia and in the whole world, for, although certain peaks in the Himalaya are more elevated, the passes are decidedly lower. M. Grenard's description of the hydrography of Turkestan and Tibet is also of much interest, especially with regard to the hitherto almost unknown upper courses of the Yang-tse and Mekong. The Chinese maps of both of these streams are very defective, and many modifications have been introduced by M. Grenard's surveys. While discussing the streams of

* 'Mission Scientifique dans la Haute Asie,' Troisième Partie. Paris: Leroux, 1898.

Eastern Turkestan, he holds that the changes which the plain has undergone are chiefly due to the action of the waters, and of the material which they carry, together with a diminution of humidity, though the effects of this last have, he thinks, been greatly exaggerated. A series of sketches by M. de Rhins, reproduced in facsimile, throw much light on the topography of the route, while the results of the journey as regards geology, botany, hypsometry, and other branches of science, are given in appendices.

The Morphology of the Tian-Shan.—A careful study of the morphology of the Tian-Shan is contributed by Dr. M. Friederichsen to the *Zeitschrift* of the Berlin Society, the first part appearing in the first number of that publication for the present year. While recognizing, with Richthofen, the connection which exists between the Tian-Shan proper and the Altai on the one hand, and the Alai-Pamir and Hindu-kush on the other, the writer subjects to a scientific analysis only the central part of the great system, with regard to which his aim is to present a view of its horizontal and vertical composition, as well as of its hydrographical, geological, and climatic relations; the attempt being justified, in his opinion, by the great bulk of material in the Russian language not yet worked up and not accessible to the great body of students. After a useful summary of the work of scientific explorers in the Tian-Shan, Dr. Friederichsen proceeds to sketch the general characteristics of the range, before dealing at length with the horizontal disposition of its component parts. The most marked feature is, he says, the regularity which prevails as regards the direction and arrangement of the separate chains, the mean direction of which may be taken as from west by south to east by north, the gentle curvature observable in a general view of the Tian-Shan being due to the influence of neighbouring ranges running in from the north-west. These general features make their influence felt in many ways, determining the directions of streams, and affecting also the course of human history within the range. In the angle formed by the meeting of the two directions settlements find shelter, while by widening out in the west into a series of parallel chains the range favours communication, just as it hinders the same where united into an unbroken wall in the east. We cannot here follow the writer in his detailed analysis of the range, but his conclusions may be briefly alluded to. The existence of *two* directions diverging in opposite ways from an east-to-west line is, he says, plainly recognizable; the one varying from E. by N. to (rarely) N.E., the other from W. by N. to (frequently) N.W. The direction which dominates the range as a whole (W. by S. to E. by N.) prevails especially in the west, while in the east one from W.N.W. to E.S.E. predominates. This fact supplies the basis for a division of the Tian-Shan into an eastern and a western half, meeting each other at an angle, the dividing line running along the Ili and Kunges valleys and south to the Tarim at Kucha. In spite of difference in internal structure, the two sections present some marked analogies in external form. Dr. Friederichsen concludes his first instalment by noting the existence of curves due to the fusion of chains with different directions. The orography of the range is shown on an excellent map, over which, for the sake of clearness, the network of travellers' routes is given separately on transparent paper.

The Aborigines of Formosa.—A society was formed last year at Tamsui for the comprehensive study of the aborigines of Formosa and their habitat, by means of journeys into the interior and the publication of memoirs on the subject. Several such have already appeared from the pen of a Japanese named Ino Kakyo, and one of them is reproduced in German in a recent number of the *Zeitschrift* of the Berlin Geographical Society. The writer begins by attempting a division of the Formosan aborigines into groups and tribes, defining four of the former and eight of the latter (with subordinate divisions), on the basis of their physical and

moral characteristics. This subdivision is, he says, of a character subordinate to the idea of "race" or "branch," it being probably possible, by a study of the common characteristics of the people in question, to refer them all to a single such category. The greater part of the paper is taken up with a discussion of the present position of the Formosans in the scale of civilization, the differences observable in this respect being, the writer holds, not original, but acquired during the process of development. He finds that considerable progress has been made in the development both of intelligence and of moral sense, as well as of the religious idea, and concludes that the Formosans are by no means at the lowest stage of culture. Their civilization will depend on the care which is taken to avoid arbitrary measures, and gradually educate them up to the reception of new ideas. Due regard being paid to these points, there is no necessity, the writer thinks, that they should share the fate of the Tasmanians and other primitive tribes which have felt the fatal influence of contact with civilization.

AFRICA.

Mr. Codrington's Expedition.—We have received the concluding portion of Mr. Codrington's journal kept during his expedition to Livingstone's tree, of which some account was given in our last number. Before leaving the spot on which the tree had stood, a fence was built round the stump, and all trees cleared away for 60 yards round, while a sealed bottle was buried within the enclosure. On May 14 the return journey was commenced, the Lulimalu river being crossed and the march continued across dry grassy "dambos," alternating with ridges or belts of trees. During the next few days a number of rivers flowing to the Luapula, Bangweulu, and the Chambezi were crossed. Of these the Lokulu was a strong deep stream, 350 yards wide, while the Lolingela was 1000 yards wide. On May 18 the Chambezi was reached, and descended for 7 miles to the confluence of the Lolingela, which runs in from the south, the Chambezi afterwards turning northwards. Soundings in the latter gave a depth of 19 to 20 feet. Before reaching Bangweulu the open water ceases, there being only canals for canoes through the grass. At Chirabe island also there is no open water to the east or south-east. Observations for altitude at the camp on the Chambezi gave as result 3791 feet. On May 20 the expedition began ascending the Chambezi, which had a current of 1½ mile an hour; but on the 22nd the boats were sent up the Chambezi and Lukulu, while Mr. Codrington proceeded overland through the Awemba country. Many streams were crossed, and on the 24th the country was well wooded, with small villages every few miles. At Kasama (4246 feet by mean of seven boiling-point observations) an "indaba" was held in the presence of several Europeans then in the place, and a successor to the chief Mwamba appointed. On the 30th the borders of Ketiamkulu's territory were reached. During the latter part of the day the country was uninhabited, with a splendid timber belt and outcrops of stratified rocks. The Chambezi was again struck on June 1, it being then 30 yards wide with steep banks, and two days later its tributary the Chozi was crossed. On June 4 the station of Ikawa was reached, the mean of ten observations giving its altitude as 5279 feet.

Dr. Pleyn's Explorations in the Congo Basin.—News of the expedition recently sent out by way of the Congo to the south-east corner of the Cameroons territory appears in the *Deutsches Kolonialblatt* for August 1. After superintending the construction of a station on the bank of the Ngoko, within the German sphere, Dr. Pleyn set out on April 28 last to explore the upper course of that river (the western branch of the Sanga), which for a certain distance forms the boundary between French and German territory. After passing one or two villages of the Misanga, an entirely uninhabited district, traversed only by hunting-parties,

was entered. On May 1, Dr. Pleyn reached the confluence of the Bumba and the Ja, which, coming from the north and west respectively, unite to form the Ngoko. The Ja is, however, decidedly the more important of the two, being about 150 yards wide at its mouth, while the Bumba is only about 100. The latter, which was first explored, is a very rapid stream, and rapids were encountered at which it was necessary to unload the canoes, progress being at last entirely stopped by a cataract in about 2° 30′ north, 14° 30′ east. Before this, villages of the Kunabembe had been visited, at which the travellers received a friendly reception. On May 6 the ascent of the Ja was commenced. Beyond the last settlement of the Misanga and four small villages of the Bomabassa, Dr. Pleyn passed for four days through quite uninhabited country, which became more and more mountainous, the river winding between hills and ridges covered with dense forest, and rising to a height of over 2000 feet above its banks. On May 14 a lake-like expansion surrounded by mountains was reached, into which the Ja poured itself through a narrow gorge containing several rapids. This proved the limit of navigation, though the stream was examined on foot above the gorge, where it again widened out to 150 yards. From the rapids (the position of which is roughly estimated as in 7° 30′ north, 13° 40′ east) to the embouchure of the Ngoko into the Sanga, the stream is navigable even for the larger river steamers, its bed being cut deeply in rocky ground. The Bumba is less favourable, as steamers could not ascend more than about 13 miles above its mouth. The whole country is covered with primeval forest, in which rubber abounds, but the oil-palm occurs only singly. Elephants are very numerous. According to native information, very long distances have to be traversed beyond the rapids on the Ja and Bumba before any settlements are reached. Even on the lower courses of the rivers population is extremely scanty. Besides the Misanga, most of the tribes met with are classed under the common designation Nzimu, or bush-dwellers, who avoid the immediate vicinity of the rivers, and are said to be undoubtedly related to the Fan. There are also tribes of wandering elephant-hunters, without fixed habitations, known as Badyiri, Bakollo or Bayaka, under which last name they were met with by Crampel two degrees further west. At the time of writing, Dr. Pleyn was about to proceed to Nzimu, on the Sanga.

West African Rubber.—A mission to West Africa for the study of the rubber plants of that region and their cultivation has been entrusted by the committee on Colonial Agriculture in Berlin to Herr Schlechter, who in the *Deutsches Kolonialblatt* for August 1 describes his visit to Lagos and the Cameroons in prosecution of his inquiries. During an excursion in the interior of Lagos he collected samples of the *Kicksia* milk and seeds of the tree for introduction into the Cameroons. The forests in which it once abounded now possess but few of the trees, and Herr Schlechter considers that its day is over in Lagos, unless efficient measures for its propagation are taken by the authorities. The order lately issued forbidding it to be touched for four years must, he says, be ineffectual owing to the absence of adequate control. Herr Schlechter discovered an apparently new species of *Ficus* in Lagos, which yields rubber of a fair quality, but which it would not pay, according to an expert who has examined the product, to cultivate in plantations. The species of *Kicksia* are, however, in Herr Schlechter's opinion, especially suited for cultivation, as they appear to grow best in thick forest, and therefore the complete clearing of the ground is unnecessary when forming a plantation.

The Harmattan in Upper Guinea.—Although the phenomenon of the Harmattan has long been familiar as a characteristic of North-West Africa, it was only since the inauguration, within recent years, of regular meteorological observations in the interior of the country, that any accurate conclusions could be

drawn as to its causes. Considerable space is devoted to the subject, as elucidated by such observations, in the first number of the *Mitteilungen aus den Deutschen Schutzgebieten* for the current year, in which Drs. Gruner and Mischlich and Lieut. von Seefried severally discuss the question, while Prof. V. Danckelman sums up the conclusions to which he is led personally from an examination of the data. While the general idea has been that the Harmattan is a hot wind blowing from the Sahara, Drs. Gruner and Mischlich deny its connection with the desert. The former gives as the chief meteorological characteristics of the dry season in the interior: (1) Continuous east, north, and north-east winds; (2) continuous great, but varying, dryness of the atmosphere; (3) perpetual haze; (4) occasional great falls of temperature by night. The *régime* of the winds is, he holds, due merely to the position of the region relatively to the sea and the continental steppe, and he accounts for the dust which fills the air by the influence of ascending currents, on which Dr. Mischling also lays stress. The phenomena of the Harmattan are therefore due, in Dr. Gruner's opinion, to the existence of extreme dryness in regions with a prevailing steppe character. Dr. von Danckelman is inclined to dissent from these views, which rest on the assumption that the atmospheric haze (a characteristic of the whole dry season) is the central phenomenon in the Harmattan. This may be justified on etymological grounds, but the problem as generally understood consists in accounting for the irregular recurrence of periods of excessive dryness, coinciding with remarkably low morning temperatures. The latter are probably due to excessive nocturnal radiation, but the connection of this with the dryness of the atmosphere is not so obvious. From a study of the observations, Dr. von Danckelman concludes that periods of dryness and low temperature occur only when a northerly direction of the wind predominates, and that the Harmattan in the narrower sense is therefore due to a temporary intensification of the conditions of wind which prevail in the western Sudan at this season. The excessive dryness is due to the nature of the countries north of the Niger, while to be charged with dust is probably a general characteristic of the winds of the region at the season in question.

Geological Exploration in German East Africa.—An expedition under Dr. Dantz has lately carried out an extensive journey in German East Africa, for the purpose of geological research, returning to Dar-es-Salaam in April last. The main results are briefly stated in the *Deutsches Kolonialblatt* for June 1. The expedition traversed the whole country as far as the Victoria Nyanza, the turning-point being the mountainous country of Shashi, north-east of Speke gulf. The southern edge of this district, which falls steeply to the Kuwaua (Ruwana?) river, is marked by an important line of disturbance, which is continued on the south side of the Kiruwiru range and of Ukerewe island. In South Shashi the prevailing rock is a reddish granite or gneiss, while further north the ferruginous schists which elsewhere have been found to contain gold attain an unusual development. Further south, in an uninhabited tract east of Ntussu, which was traversed for the first time during the return march, similar schists with quartz and diabase form continuous ranges, interposed between the plateau lands on either side. Water is apparently to be found there during the greater part of the year. The great uninhabited "Pori" west of Lake Eyassi seems to be an unbroken zone of gneiss. Its surface is much cut up by the beds of streams. The Wembere-Eyassi trough is not sharply defined to the north of the Simbiti river, except in the vicinity of the lake, but its southern edge is well marked. The great East African rift-valley is particularly well marked to the west in Ussandaui and Ungenganya, though its eastern edge is masked by the Irangi mountains. Very little rain falls here, by reason of the higher ground which intercepts it on either side. The Mkata plain east of Kilossa is regarded

as equally due to subsidence, its walls running from south-west to north-east. Dr. Dantz has also defined the geological formations nearer the coast, and studied the agricultural capabilities of the various districts. These depend almost entirely on the amount of precipitation, and this is most favourable, Dr. Dantz considers, west of Ugogo as far as the lakes.

Journey to Bauchi, Nigeria.—The report of a journey made last year from Ibi, on the Benue, to Bauchi (Yakoba), for recruiting purposes, by Lieuts. Bryan and Macnaghten, lately issued by the Colonial Office, contains some details of interest as to the present state of the country. Starting from Ibi on June 15, with a caravan of 138 carriers, the two officers left the Benue at Amara on the 23rd, and proceeded *viâ* Gatari (about 2000 inhabitants), through a country hilly or rocky in places, and generally covered with short scrub, with patches of cultivation. Of the rivers crossed, the Gende, 250 yards wide, in two channels, with a current of 3 miles an hour, was the most important. Bauchi was reached on July 13. It has a good wall, with banquette and ditch, and probably contains 20,000 inhabitants. An interview with the Emir was obtained, but the people were somewhat suspicious, and only after some hesitation was permission given to enlist recruits, while steps were afterwards taken to nullify the permission. The want of confidence experienced is ascribed by Lieut. Bryan to ignorance of the white man. Bauchi has a good market, and Manchester goods were fairly plentiful, but seemed to have come across the desert from Tripoli, more than from Ibi. On the return journey the caravan, after crossing the Gende (a work of some time, owing to a rise in its level), traversed the Missu country, being well received at Maimadi, a large walled town of 6000 inhabitants (Hausa and Fulani). Ako, a strong independent town of 8000 inhabitants, was also visited. The caravan routes are much infested by pagan tribes occupying tracts of hilly country in their vicinity, one of them—the Tangele—being cannibals. Information was also collected respecting other pagan tribes on the Benue. Lieut. Bryan thinks time will be required to foster legitimate trade, though the agricultural wealth of Bauchi and Missu is considerable. Tin is obtained near Bauchi, and iron is smelted in many places.

AMERICA.

The First Discovery of the Madre-de-Dios.—A document of some interest to historical geographers has recently been published at Seville by Señor Luis Ulloa. It is printed from a manuscript which exists in the 'Archivo general de Indias,' describing the expedition of the conquistador Juan Alvarez Maldonado, in 1567, from the Peruvian cordillera into the Amazonian forests, respecting which very little has yet been published. The *Relacion* is not the work of Maldonado himself, but of one of his companions—possibly, the editor thinks, the pilot Hernando Alonso. The authenticity of the manuscript, he says, admits of no question, and the precision of the geographical data, judged in the light of modern knowledge, is surprising. Señor Ulloa credits Maldonado with the discovery of the whole course of the Amaru-mayu or Madre-de-Dios, and even identifies one of the streams mentioned in the *Relacion* with the Beni. The Madre-de-Dios itself is named the Manu, which name coincides with that of one of its headwaters explored a few years ago by Señor Fiscarrald (*Journal*, vol. vii. p. 189). Other names of tributaries agree with those now in use, and the old account also mentions the Araonas, Toromonas, Guarayos, and other tribes met with by recent explorers on the Madre-de-Dios. The editor gives a short sketch of the career of Maldonado, and also of the journeys made by his predecessors in the Amazonian forests. He holds that Garcilasso's account of the descent of the Amaru-mayu by the Inca Yupanqui is untrustworthy, and that that writer confounded a real expedition of the Incas to the Moxos of the

Beni with that of Maldonado to the Madre-de-Dios. The Spanish captains Pedro de Candia and Pero Anzures de Camporredondo explored the country south of the latter stream, and none of the missionaries who visited the Araonas and Chunchos before Maldonado's time seem to have reached its waters; so that the credit of the discovery, Señor Ulloa holds, belongs to the last-named captain. It seems open to question, however, whether Maldonado really advanced eastward so far as Señor Ulloa supposes.

POLAR REGIONS.

Return of the "Windward."—The arrival of the *Windward* at Brigus in Conception bay, Newfoundland, was announced by telegram from St. John's on September 10. News was brought by the ship regarding the expeditions both of Peary and Sverdrup, neither of which appear to have yet advanced far beyond the limits of the known. During a severe storm in January, several of Peary's party suffered from frost-bite, involving the loss of toes. During the previous autumn Peary had explored the coast of Grinnell land to its western extremity, but no unexplored point in the direction of the Pole had been reached. The explorer will again winter in the far north and continue his work for three years more, if need be, the *Windward* returning north next spring. Captain Sverdrup had wintered 50 miles south of Peary. The following report, stated to be from Lieut. Peary, is published in a Christiania journal: "In the course of the winter Captain Sverdrup thoroughly explored Ellesmere land. He intends in the summer to advance as far north as possible. If it is not possible to get away further with his ship he will go by sledge on land with a portion of his party, and follow a part of the coast of Greenland hitherto untrodden northwards and eastwards as far as Independence bay, where he hopes to be picked up by the *Fram* in a year or possibly two. He intends in the autumn to send the *Fram* round Cape Farewell and up the east coast, where, as already stated, he proposes to meet her."

Dr. Nathorst's Expedition to East Greenland.—During September the *Antarctic* with Dr. Nathorst's party on board arrived at Malmö from the east coast of Greenland. No trace of Andrée had been found, but good exploring work had been accomplished, many new inlets being discovered and charted in the neighbourhood of Franz Josef Fjord. Valuable ethnographical results were also obtained respecting the now extinct Eskimo population of that region.

The Botanical Aims of South Polar Research.—A paper on this subject by Dr. F. W. Neger appears in the *Mitteilungen* of the Leipzig Geographical Society for 1898. The writer begins by pointing out that, although at first sight the antarctic lands are marked by extreme poverty in vegetable life, the fact of the existence of a comparatively extensive fauna in the coast waters proves that the flora too must there be fairly abundant. The almost entire blocking of the coasts by land-ice must, it is true, stand in the way of the development of a littoral flora which consists elsewhere chiefly of green *algæ*, but the second or sub-littoral zone will probably be found to possess a rich flora (brown or red *algæ*), it being well known that these organisms are able to flourish in spite of intense cold, while in the north they have been found to depths of 150 fathoms, below the disturbing influence of the land-ice. A wide field is also open for the investigation of the *Plankton* of the southern seas, as also of the distribution of the marine flora and the manner in which this is affected by variations of salinity. A number of most interesting problems depend for their solution also on a knowledge of the past and present land-flora of the Antarctic. In view of the surprising contrasts presented by the botany of the southern hemisphere, it is by no means impossible that vascular plants may be discovered within the fringing ice-wall, it being probable that isolated

spots may be free from ice owing to the influence of volcanic heat or other causes. Dr. Neger goes fully into the question of the former distribution of land and water and of climatic changes in the Antarctic, showing the great interest, in this connection, which would attach to the discovery of fossil forms of vegetation. He points out the grounds for believing that the antarctic continent was once more suited than at present for the growth of plants, and that this may explain the strange admixture of forms between South America, Australia, and other southern lands. The similarity of the flora of Kerguelen Land, Marion island, and Heard island, separated as they are by wide tracts of ocean, may be also explained, he thinks, by the supposition that the plants were transported by drift-ice from the Antarctic. As regards the former changes of climate which may have taken place in the southern hemisphere, Dr. Neger remarks that any remains of plants that may be found in the Antarctic must be older than the long cold period which occupied the Tertiary epoch. If at an earlier date the southern continent was covered with vegetation, the forests would probably have consisted of *Araucariæ* and other conifers of the habit of *Libocedrus* and *Podocarpus*, and of foliage trees such as *Nothofagus*.

Danish Expedition to East Greenland.—We have already * given some information about an expedition to the unexplored part of the east coast of Greenland between Angmagsalik (65¾° lat.) and Scoresby sound (70°) under command of Lieut. Amdrup, R.D.N. The expedition, which left Copenhagen in August, 1898, for Angmagsalik, returned on September 12 last, and has carried out the first part of its plan, exploring the coast up to 67½° with boat and dog-sledges, and establishing two depôts at 66° 6′ and 67° 15′. At the last place the expedition found the remains of a small extinct Eskimo settlement of about thirty persons. The ethnographical remains found here are interesting, and the expedition has, during its sojourn in Greenland, made different scientific observations concerning botany, zoology, magnetism, etc. The lowest temperature was −30° Celsius (−22 Fahr.). The expedition consisted of the leader, Ch. Kruse, botanist and geologist; K. Pontsen, zoologist; S. Jacobsen, a naval petty officer; and Nielsen, sailor and smith. The second part of the work of the expedition (which will probably start next year) consists in an exploration of the coast from Scoresby sound southwards, after which the expedition will return *viâ* Angmagsalik, a Danish mission and trading station, to which the government sends a ship every year in August.

GENERAL.

A New Ethnological Text-book.†—Under the title 'Man: Past and Present,' Mr. A. H. Keane contributes a new volume to the *Cambridge Geographical Series*, intended to supplement his 'Ethnology,' which appeared as the first issue of that series. Whereas the latter dealt mainly with general questions relating to the human race as a whole, the new volume is intended rather as a systematic account of the four principal divisions into which mankind is divided by the author, with especial reference to their geographical habitats, and to the subject of the origin and inter-relations of the different subordinate groups. It is, therefore, quite complete in itself, though reference is constantly made to the earlier volume, in which fundamental questions have been more fully treated. As a guide to the present state of knowledge on the various branches of the human family, their social institutions and religious ideas, the new volume supplies a long-felt want, and is a monument of comprehensive acquaintance with the results of modern research, and with the vast body of facts which have been collected on the subject.

* Vol. x. p. 18.

† 'Man: Past and Present.' By A. H. Keane, F.R.G.S. Cambridge University Press. 1899.

As a text-book it is perhaps somewhat too much a statement of the author's personal views on controverted points, contrary opinions being often rather summarily dismissed. The distinction between "reasonable assumptions" and positive facts is also, perhaps, not always kept up as clearly as might be wished. The main conclusions of the author have already been put before students in his earlier volume, and need not be repeated at length here. They all rest on the belief that the world was peopled from one eastern centre during Pleistocene times, and that the primary groups were already specialized before the Neolithic epoch, or, according to Mr. Keane's ideas, at least 100,000 years ago. The results of some recent researches, which have appeared since the date of the 'Ethnology,' have, however, been embodied. Thus, Prof. Sergi's important work on the Hamitic race has been utilized and its conclusions in the main accepted, together with those of other inquirers in the same field, which point to the ethnic unity of the Berbers and of the peoples which form the basis of the south European populations. This has, of course, an important bearing on the question of the European races generally, which are divided by Mr. Keane (with De Laponge and Ripley) into three primary groups, characterized briefly as tall, blonde long-heads; short, dark long-heads; and brown round-heads. As the designation for the primary division to which all these, as well as the Semites, etc., belong, he vigorously defends the old term Caucasic, which, he says, possesses the valuable quality of prestige, and is certainly open to no more objections than Semitic or Hamitic. The original home of the Caucasic peoples Mr. Keane places in North Africa, that of the Mongolians in Tibet, while no such restricted areas are assigned as the primæval homes of the American aborigines and the Negroes. As elsewhere, Mr. Keane draws a decided line of partition between the Sudanese and the Bantu negroes, while classing the latter with the Hottentots, Bushmen, and Negritoes. Yet he allows that, physically, no hard and fast line can be drawn between the Sudanese and Bantu. With regard to the Malagasy problem, which he considers to have been somewhat needlessly revived of late years, the author lays stress on the very early date of the original Malay immigration, which, he says, is no matter of speculation, but a direct inference from established facts. Enough has been said to show the varied nature of the questions discussed, and, however they may dissent from the views of the author, all readers of his book will find abundant matter to stimulate their interest. There is a useful series of illustrations, from photographs, of the various types described.

The Science of Map-making.—In a recent publication of the Maryland geological survey, Mr. Henry Gannett gives a succinct and clear exposition of the aims and methods of cartography, with special reference to the topographic maps now under construction in Maryland. A large part of the paper is, of course, taken up with technical details as to the methods and instruments employed; but the introductory matter, dealing with general principles and desiderata to be kept in view in map-making, is of wider interest. Mr. Gannett distinguishes between "geographic maps," or those upon small scales usually compiled from others on larger scales, and "topographic maps" upon large scales, often made directly from surveys. To the latter his chief attention is directed. As regards the general methods of map-making, he remarks that every map, whatever its character, is essentially a sketch corrected by locations. The work of making a map, therefore, consists of two parts: that of making these locations, which is done by surveying-instruments, and is geometrical; and that of sketching, which is done by the eye and hand, and is artistic. The correctness of maps depends upon four elements: (1) accuracy of location; (2) the number of locations per square inch of the map; (3) their distribution; and (4) the quality of the sketching. The greatest accuracy attainable is not always desirable, but the degree of correctness must depend on the end in view. After discussing the amount of control necessary in different

cases, and the two general methods (by triangulation or traverse) of location of stations, the writer corrects a "widespread misapprehension regarding the possible accuracy of maps," showing that, owing to the amount of generalization necessary, absolutely "perfect maps" are an impossibility. In his detailed account of the methods employed, Mr. Gannett treats in turn of (1) the location of the map upon the Earth's surface by astronomical observations; (2) the horizontal location of points, in three grades of accuracy; (3) the measurement of heights; (4) the sketching of the map—by far the most important part of the work of map-making. He also describes the various instruments employed, and their mode of use.

CORRESPONDENCE.

The Khotan River.

With reference to Colonel Trotter's remarks on pages 447 and 448 of the *Geographical Journal* for April, 1899, which I have only just received, I beg to state that I am perfectly familiar with the upper waters of the Kiria river and its four chief tributaries, and that I did not mistake any of the above for the Khotan river, whose sources I discovered. The river referred to as having been crossed by Kishin Sing in lat. 35° 3′, long. 81° 30′, flows into a lake marked on sheet No. 1 of my map of Western Tibet as "lake approximately fixed," in lat. 35° long. 81°. Aksu is on the western tributary of the Kiria river, not on the main river, and the sources of the Khotan river are, roughly speaking, south-west of that place. As regards my longitudes, I do not wish to again refer to them until all my observations have been re-computed and checked. The Khotan river cannot possibly flow south for 30 miles, or anything like that distance, from its source, as a high snow range intervenes between it and the river said by Kishin Sing to flow into the Khotan river.

H. H. P. Deasy.

Leh, July 29, 1899.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. = Memoirs, Mémoires.
Met. = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Belgium—Meteorology. ———

Résumé des Observations Météorologiques faites à l'Observatoire Royal de Belgique, à Uccle pendant l'année 1898. Bruxelles, 1899. Size 7½ × 5, pp. 16. *Presented by M. A. Lancaster.*

Belgium—Sunshine. **Lancaster.**

De l'intérêt des relevés journaliers des heures de Soleil. Par A. Lancaster. Bruxelles, 1899. Size 7½ × 5, pp. 24. *Diagrams. Presented by the Author.*

On the importance of measuring the daily duration of bright sunshine with statistics of sunshine for Brussels for twelve years. A diagram is given, comparing graphically the average percentage of possible sunshine for each month enjoyed at Madrid, Rome, Uccle, Hamburg, and Ben Nevis.

Central Europe—Plants. **Schulz.**

Entwicklungsgeschichte der Phanerogamen Pflanzendecke Mitteleuropas nördlich der Alpen. Von Dr. August Schulz.—Forschungen zur deutschen Landes- und Volkskunde . . . herausgegeben von Dr. A. Kirchhoff. Elfter Band, Heft 5. Stuttgart: J. Engelhorn, 1899. Size 9½ × 6½, pp. 229-447.

Danube. *B.S.G. Română* **19** (1898): 19–36. **Sturdza.**

Lucrările Comisiunei Europeane a Dunărei, conferință de D. Dimitrie A. Sturdza. Rezumat în limba franceză.

The report in French of a lecture on the Danube, delivered to the Rumanian Geographical Society.

Denmark. **Boyle.**

Trade and Agriculture of Denmark for the year 1898. Foreign Office, Annual No. 2301, 1899. Size 10 × 6½, pp. 22. *Diagram. Price* 2½*d.*

Europe—Cartography. *Ymer* **19** (1899): 159–170. **Tottie.**

Om fortgången af Europas allmänna topografiska kartarbeten under innevarande decennium. Af Ch. D. Tottie. *With Maps.*

On the progress of the official mapping of Europe since 1889, with maps showing the present state of the topographical, geological, and marine surveys of Norway and Sweden.

Europe—Preglacial Geography. **Hildebrandt.**

Naturw. Wochenschrift **14** (1899): 261–267.

Die Westgrenze des letzten nordeuropäischen Inlandeises. Eine Diluvialstudie von Max Hildebrandt. *With Map.*

Europe—Travel. ———

London to Switzerland and Italy by the St. Gothard Railway. 100 Picturesque Views. Nancy: A Bergeret & Cie. Size 13 × 10. *Presented by the Compagnie des Chemins de Fer de l'Est.*

Faroe Islands. *Geolog. Mag.* **6** (1899): 308–309. **Lomas.**

Glaciated Valleys in the Faroes. By Joseph Lomas.

Faroe Islands. *G. Tidskrift* **15** (1899): 29–36. **Willaume-Jantzen.**

Færøernes Klima. Af V. Willaume-Jantzen.

France. **Babinet and Lemoine.**

Résumé des Observations centralisées par le Service Hydrométrique du Bassin de la Seine pendant l'année 1897. Par M. Babinet. Versailles, 1898. Size 10½ × 7, pp. 52 and 8.

Observations sur les Cours d'Eau et la Pluie centralisées pendant l'année 1897. . . . Par M. G. Lemoine et M. Babinet. [7 Plates.] Size 18 × 11½.

France. *B.S.G. Lille* **31** (1899): 411–428. **Cantineau.**

Les Excursions de la Société de Géographie de Lille en 1898: A travers les Vosges et le Jura. Par M. E. Cantineau. *With Illustrations.*

France. *B.S.G. Com. Bordeaux* **22** (1899): 191–199, 217–225. **Imbert.**

Quelques ports maritimes français de l'Atlantique. Par Louis Imbert.

Particulars of the capacity and equipment of the chief French seaports on the Atlantic.

France. **Lee.**

Trade of France for the year 1898. Foreign Office, Annual No. 2213, 1899. Size 9½ × 6½, pp. 30. *Price* 2*d.*

France—Bay of Biscay. **Odin and Rabilier.**

Carte des parages de pêche du thon dans le golfe de Gascogne. Par A. Odin et G. Rabilier.—Congrès International de Pêches Maritimes, Comptes rendus des Séances. Paris, 1899. Pp. 53–66. *Map.*

On the limits within which the fishing for the germon, or white thon (*Thymnus thymnus*), is carried on.

France—Bordeaux. **Hearn.**

Trade of Bordeaux and District for the year 1898. Foreign Office, Annual No. 2250, 1899. Size 10 × 6½, pp. 58. *Price* 3*d.*

France—Coasts. *B.S.G. Paris* **20** (1899): 182–197. **Thoulet.**

Considérations relatives à la construction d'une carte lithologique des côtes de France. Par M. J. Thoulet.

A proposal to construct a detailed map showing the nature of the sea-bottom off the coast of France.

France—Corsica. *Ann. G.* **8** (1899): 304–329. **Ratzel.**

La Corse. Étude anthropogéographique. Par M. Friedrich Ratzel.

France—Ushant. *Tour du Monde* **5** (1899): 289–300. **Gruyer.**

Ouessant (Enez Heussa—L'Ile de l'Épouvante). Par M. Paul Gruyer. *With Illustrations.*

Germany. ———

Siebenter Internationaler Geographen-Kongress Berlin 1899. Programm der Wissenschaftlichen Ausflüge. Berlin, 1899. Size 11½ × 9, pp. 16.

A list of the excursions planned in connection with the Berlin Geographical Congress, each being accompanied by a detailed list of books and memoirs covering most of the Baltic coast of Germany and the Rhine valley.

Germany—Bavaria. *Altbayerische Monats.* **1** (1899): 1–21. **Oberhummer.**

Ueber die Entwicklung und die Aufgaben der bayerischen Landeskunde. Von Prof. Dr. Eugen Oberhummer. *With Maps and Illustrations.*

Germany—Fichtelgebirge. *M.V. Erdk. Leipzig* (1898): 55–195. **Nüchter.**

Das Fichtelgebirge in seiner Bedeutung für den mitteleuropäischen Verkehr. Eine anthropo-geographische Studie von Friedrich Nüchter.

On the influence exercised by mountains, and especially by the Fichtelgebirge, on the lines of communication through Europe.

Germany—Fisheries. *Rev. Maritime* **140** (1899): 445, 671; **141** (1899): 197. ———

Les pêches maritimes en Allemagne. *With Illustrations.*

Germany—Hamburg. **Ward.**

Trade of Hamburg for the year 1898. Foreign Office, Annual No. 2263, 1899. Size 10 × 6½, pp. 70. *Price* 4*d.*

Germany—Meteorology. **Bezold.**

Veröffentlichungen des Königlich Preussischen Meteorologischen Instituts, herausgegeben durch dessen Direktor Wilhelm von Bezold. 1898. Heft ii. Ergebnisse der Beobachtungen an den Stationen II. und III. Ordnung im Jahre 1898 zugleich Deutsches Meteorologisches Jahrbuch für 1898. Berlin: A. Asher & Co., 1899. Size 13½ × 10, pp. 57–110. *Presented by the Prussian Meteorological Institute.*

Germany—Saxony. *M.V. Erdk. Leipzig* (1898): 17–53. **Hassert.**

Die geographische Lage und Entwickelung Leipzigs. Von Privatdozent Dr. Kurt Hassert.

On the geographical position of Leipzig and the development of the town.

Germany—Trade. **Oppenheimer.**

Trade of Frankfort-on-Main for the year 1898. Foreign Office, Annual No. 2312, 899. Size 10 × 6½, pp. 64. *Price* 3*d.*

This report deals with the trade of the German empire, the Consul-general, Sir Charles Oppenheimer, passing in review the present situation, and giving a statistical summary of the trade between the United Kingdom and Germany for ten years.

Greece—Amorgos. *B.S.R. Belge G.* **23** (1899): 90–108, 145–171. **Hauttecœur.**

L'île d'Amorgos. Par Henry Hauttecœur. *With Map.*

Greece—Ionian Islands. **Dupuis.**

Trade of the Ionian Islands for the year 1898. Foreign Office, Annual No. 2269, 1899. Size 9½ × 6½, pp. 20. *Price* 2*d.*

Europe—Hanse Towns. *B. American G.S.* **31** (1899): 236–255. **Semple.**

The Development of the Hanse Towns in Relation to their Geographical Environment. By Ellen C. Semple. *With Maps.*

Holland. *B.S.G. Lille* **31** (1899): 235–256, 381–401. **De Swarte.**

Au pays de Rembrandt et de Frans Hals. Coups de crayon sur un Carnet de voyage par Victor De Swarte.

Hungary—Lake Balaton. ——

Resultate der wissenschaftlichen Erforschung des Balatonsees. Herausgegeben von der Balatonsee-Commission der Ung. Geographischen Gesellschaft. Zweiter Band. Die Biologie des Balatonsees und seiner Umgebung. Erster Theil. Die Fauna des Balatonsees. Von Dr. Karl Brancsik, Dr. Eugen v. Daday, Raoul Francé, Dr. Alexander Lovassy, Ludwig v. Méhelij, Dr. Stefan v. Rátz, Dr. Karl Szigethy und Dr. Eugen Vángel. Wien: E. Hölzel, 1897. Size 11½ × 8½, pp. xl. and 280. *Illustrations. Presented by the Hungarian Geographical Society.*

Iceland. *G. Tidskrift* **15** (1899): 3–14. **Thoroddsen**

Højlandet ved Langjökull paa Island Rejseberetning fra Sommeren 1898 af Dr. phil. Th. Thoroddsen. *With Map.*

This memoir is accompanied by a geological map of the belt of country between Hunafloi and Faxafjord.

Iceland. **Vidalin.**

Trade of Iceland for the years 1895-98. Foreign Office, Annual No. 2285, 1899. Size 10 × 6½, pp. 18. *Price* 1½*d.*

Italy. *B.S.G. Italiana* **12** (1899): 249–256. **Baratta.**

Alessandro Volta ed i suoi studi sulle fontane ardenti di Pietramala e di Velleja. Notizie del Socio M. Baratta.

Italy—Elba. **Tonietti.**

Trade of the Island of Elba for the year 1898. Foreign Office, Annual No. 2274. 1899. Size 9½ × 6½, pp. 12. *Price* 1*d.*

Italy—Emigration. *Questions Dipl. et Colon.* **7** (1899): 201–209. **Ebray.**

L'émigration italienne et la Colonisation. Par M. Alcide Ebray.

Italy—Lakes. **Agostini.**

Terzo Congresso Geografico Italiano. Sullo stato attuale degli studi batometrici dei laghi italiani coll' aggiunta di un saggio per una bibliografia limnologica italiana. Communicazione del Dott. Giovanni De Agostini. Firenze, 1899. Size 9½ × 7, pp. 12. *Presented by the Author.*

Italy—Lecce. **Cocoto.**

Trade of the Province of Lecce for the year 1898. Foreign Office, Annual No. 2311, 1899. Size 10 × 6½, pp. 48. *Price* 2½*d.*

Includes a report on Brindisi.

Italy—Leghorn. **Carmichael.**

Trade of Leghorn for the year 1898. Foreign Office, Annual No. 2241, 1899. Size 10 × 6, pp. 22. *Price* 1½*d.*

Italy—Sicily. *Riv. G. Italiana* **6** (1899): 410–419. **Oliveri.**

Sulla identificazione dei fiumi che scorrono presso Girgenti coi nomi antichi di Akragas e Hypsas. Nota del Dott. Gaspare Oliveri. *With Map.*

Italy—Sicily. *Terrestrial Magnetism* **4** (1899): 87–92. **Palazzo.**

Carte Magnétique de la Sicile. Par M. L. Palazzo. *With Map.*

Italy—Sicily. **Ricchieri.**

Terzo Congresso Geografico Italiano. Saggi di correzione dei nomi locali nelle carte topografiche dell' Istituto Geografico Militare, per quanto riguarda la Sicilia Occidentale e Meridionale. Memoria del Prof. Giuseppe Ricchieri. Firenze, 1899. Size 9½ × 7, pp. 14. *Presented by the Author.*

On the necessity for revising the local names which appear on the official maps of Sicily.

Italy—Terrestrial Magnetism. *Atti R.A. Lincei Rendiconti* **8** (1899): 22–28. **Palazzo.**

Misure magnetiche eseguite in Italia nel 1891, e contribuzioni allo studio delle anomalie nei terreni vulcanici. Nota di Luigi Palazzo.

Italy—Venetia. **Thorndike-Nourse.**

Les valli de la Vénétie. Par Thorndike-Nourse.—Congrès International de Pêches Maritimes, Comptes rendus des Séances. Paris, 1899, pp. 395–423. *Illustrations.*

The *valli* of Venice are portions of shallow sea surrounded wholly or in part by dykes and utilized mainly for fishing, while the fertile land on their borders is cultivated.

Mediterranean Basin. *J. of T. Victoria I.* **31** (1899): 111–122. **Hull.**

The Physical Conditions of the Mediterranean Basin. By Prof. E. Hull, F.R.S. *With Map.*

Mediterranean—Crete. *Questions Dipl. et Colon.* **7** (1899): 146–151. **Moguez.**

La Crète Autonome. Par E.-H. Moguez. *With Map.*

Mediterranean—Cyprus.

Cyprus. Annual Reports for 1897-8. London: Eyre & Spottiswoode, 1899. Size 10 × 6½, pp. 108. *Price* 5½*d.*

Mediterranean—Cyprus. **Gennadius.**

Report on Agriculture in Cyprus. By P. Gennadius. London: Eyre & Spottiswoode, 1899. Size 10 × 6, pp. 34. *Price* 2½*d.*

A discussion of the various agricultural products of Cyprus and their derivatives (essential oils, etc.) likely to be of commercial value for export.

Mediterranean—Rhodes. **Bukowski.**

Geologische Uebersichtskarte der Insel Rhodus. Aufgenommen und erläutert von Gejza von Bukowski (Separat-Abdruck aus dem Jahrbuch der k.k. geolog. Reichsanstalt, 1898, Bd. 48, Heft 3 und 4.) Wien, 1899. Size 10½ × 7½, pp. [172]. *Map. Presented by the Author.*

A complete study of the geology of Rhodes, with a geological map, on the scale of 1:120,000, the topographical basis of which is the British Admiralty chart of the island.

North Sea Pilot. ——

Supplement 1899, relating to the North Sea Pilot, part ii. Fifth edition, 1895. London: J. D. Potter, 1899. Size 10 × 6½, pp. 47. *Presented by the Hydrographer, Admiralty.*

Norway. **Dundas.**

Trade of Norway for the year 1898. Foreign Office, Annual No. 2299, 1899. Size 9½ × 6½, pp. 64. *Price* 3*d.*

This report shows a remarkable increase in the utilization of the natural resources of Norway, especially in the export of ice, the development of mining and manufactures, and the utilization of electric power.

Rumania. *B.S.G. Română* **20** (1899): 1–118. **Brătianu.**

Trebuinta de a se face cadastrul României. De Generalu C. I. Brătianu.

Urging the importance of a cadastral survey of Rumania in order to facilitate the registration and transfer of property.

Rumania. **Liddell.**

Trade of Roumania for the year 1898. Foreign Office, Annual No. 2305, 1899. Size 10 × 6, pp. 24. *Price* 1½*d.*

The growing prosperity of Rumania has led to the institution of a direct express train service from Berlin to Bukharest in thirty-three hours, connecting twice weekly at Kustenji with new steamers to Constantinople, which can thus be reached in forty-eight hours instead of the sixty-four hours required by the Orient express.

Russia—Finland. **Perrott.**

Finland. An English journal devoted to the cause of the Finnish People. Edited by C. Harold Perrott, B.A. No. 1, June 3, 1899. London. Size 15 × 10½, pp. 20. *Price* 3*d. Presented by the Publishers.*

The first number of a periodical intended to spread a knowledge of Finland in this country.

Russia—Novaya Zemlya. **Tschernyschew and Jakowlew.**

Verh. Russ.-K. Mineralog. Ges. St. Petersburg. **36** (1899): 55–99.

Die Kalksteinfauna des Cap Grebeni auf der Waigatsch-Insel und des Flusses Nechwatowa auf Nowaja-Semlja. Von Th. Tschernyschew und N. Jakowlew. *With Plates.*

ASIA.

Ceylon. ——

Correspondence relating to Recent Land Legislation in Ceylon, June, 1899. London: Eyre & Spottiswoode, 1899. Size 13½ × 8½, pp. vi. and 164. *Price* 1*s.* 4½*d.*

Ceylon. *J. Linnean S.* (*Botany*) **34** (1899): 300–365. **Pearson.**

The Botany of the Ceylon Patanas. By H. H. W. Pearson, B.A. *With Map.*

China. ——

Treaty Series. No. 11. 1899. Exchange of Notes between the United Kingdom and Russia with regard to their respective Railway Interests in China. London: Eyre & Spottiswoode, 1899. Size 10 × 6½, pp. 6. *Price* ½*d.*

China. ——

China: Imperial Maritime Customs. II. Special Series: No. 2. Medical Reports for the Half-year ended September 30, 1898. Shanghai; London: P. S. King & Son, 1899. Size 11 × 9, pp. vi. and 28. *Illustration.*

The medical reports include an abstract of meteorological observations.

China. *A travers le Monde, Tour du Monde* **5** (1899): 197–198. ——

La Baie de San-Moun. *With Map.*

China. *B.S. d'Études Colon.* **6** (1899): 3–48. **Bray.**

Entreprises en Chine. Par Fd. de Bray. *With Maps.*

On the opportunity for Belgian commercial enterprise in China, with sketch-maps of the projected railways.

China. *Imp. and Asiatic Quarterly Rev.* **7** (1899): 92–113. **Bullock.**

Intercourse in the Past between China and Foreign Countries. By T. L. Bullock.

China. *Verh. Ges. Erdk. Berlin* **26** (1899): 251–261. **Cholnoky.**

Herr Eugen von Cholnoky: Kurze Zusammenfassung der wissenschaftlichen Ergebnisse meiner Reise in China und in der Mandschurei in den Jahren 1896–1898.

China. **Elliot.**

The Prospect in Chinese Trade and the present opportunity. By G. F. Scott Elliot, M.A., etc. From the *Proceedings of the Philosophical Society of Glasgow.* 1899. Size 9 × 5½, pp. 20. *Presented by the Author.*

A thoroughly practical paper, dealing with the question of the production of silk and tea in China, and the demand for cotton goods. A list of over ninety recent authorities is given.

China. *Riv. G. Italiana* **6** (1899): 105–118, 216–221, 291–297, 357–367. **Gribaudi.**

L'avvenire economico della Cina. Del Dott. Pietro Gribaudi.

China. *Riv. G. Italiana* **6** (1899): 321–344. **Nocentini.**

L'Italia e la Cina. Conferenza . . . dal Prof. Lodovico Nocentini.

China. **Ricchieri.**

Prof. G. Ricchieri. L'Italia in Cina. Roma, 1899. Size 10 × 6½, pp. 28. *Presented by the Author.*

Reprint of an article in the *Rivista d'Italia* for 1899.

China—Amoy. **Little.**

Trade of Amoy for the year 1898. Foreign Office, Annual No. 2281, 1899. Size 10 × 6, pp. 18. *Price* 1½*d.*

China—Canton. *J. China Br. R. Asiatic S.* **30** (1899): 1–73. **Huart.**

Le Voyage de l'Ambassade Hollandaise de 1656 à travers la Province de Canton. Par C. Imbault Huart.

China—Chifu. **Hopkins.**

Trade of Chefoo for the year 1898. Foreign Office, Annual No. 2307, 1899. Size 10 × 6½, pp. 20. *Plan. Price* 3*d.*

This report contains a short account of Kiauchau bay, with a map, and also a notice of Wei-hai-wei.

China—Chungking. **Litton.**

Trade of Chungking for the year 1898. Foreign Office, Annual No. 2249, 1899. Size 10 × 6, pp. 18. *Price* 1½*d.*

China—Fuchau. **Fraser.**

Trade of Foochow for the year 1898. Foreign Office, Annual No. 2213, 1899. Size 9½ × 6½, pp. 16. *Price* 1*d.*

China—Ichang. **Holland.**

Trade of Ichang for the year 1898. Foreign Office, Annual No. 2280, 1899. Size 10 × 6½, pp. 10. *Price* 1*d.*

China—Kiukiang. **Brady.**

Trade of Kiukiang for the year 1898. Foreign Office, Annual No. 2308, 1899. Size 9½ × 6½, pp. 12. *Price* 1*d.*

Deals with the river trade on the Yangtze.

China—Lighthouses. ———

China: Imperial Maritime Customs. III. Miscellaneous Series, No. 6. List of the Chinese Lighthouses, Light-vessels, Buoys, and Beacons for 1899. (Corrected to December 1, 1898.) Shanghai; London: P. S. King & Son, 1899. Size 11 × 9, pp. 54. *Maps.*

China—Pakhoi. **Hurst.**

Trade of Pakhoi for the year 1898. Foreign Office, Annual No. 2228, 1899. Size 10 × 6½, pp. 10. *Price* 1*d.*

China—Railways. ———

China. No. 2 (1899). Correspondence between Her Majesty's Government and the Russian Government with regard to their respective Railway Interests in China. London: Eyre & Spottiswoode, 1899. Size 13 × 8½, pp. viii. and 92. *Price* 9½*d.*

China—Railways. *Questions Dipl. et Colon.* 7 (1899): 265–274, 321–332. **Marcillac.**

Les Chemins de fer en Chine. Par M. Jean de Marcillac. *With Map.*

China—Samshui. **Fox.**

Trade of Samshui for the year 1898. Foreign Office, Annual No. 2242, 1899. Size 9½ × 6, pp. 14. *Price* 1*d.*

China Sea. ———

The China Sea Directory. Vol. ii. Containing Directions for the Navigation of the China Sea, between Singapore and Hong Kong. (4th edition.) London: J. D. Potter, 1899. Size 9½ × 6½, pp. xxiv. and 564. *Index Chart. Price* 4*s. Presented by the Hydrographer, Admiralty.*

China—Shantung. *Petermanns M.* 45 (1899): 49–56, 82–91, 106–113. **Gaedertz.**

Eine Rekognoszierungsreise in der Provinz Schan-Tung. Von Oberingenieur A. Gaedertz. *With Map.*

China—Shashih. **Clennell.**

Trade of Shashih for the year 1898. Foreign Office, Annual No. 2258, 1899. Size 10 × 6½, pp. 12. *Price* 1*d.*

China—Swatow. **Ford.**

Trade of Swatow for the year 1898. Foreign Office, Annual No. 2238, 1899. Size 9½ × 6, pp. 16. *Price* 1*d.*

China—Trade. ———

China: Imperial Maritime Customs. I. Statistical Series, Nos. 3 and 4. Returns of Trade and Trade Reports for the year 1898. Part I.—Report on the Trade of China, and Abstract of Statistics. Shanghai; London: P. S. King & Son, 1899. Size 11 × 9, pp. 34.

China—Wuchau. **Hosie.**

Trade of Wuchow for the year 1898. Foreign Office, Annual No. 2248, 1899. Size 10 × 6, pp. 22. *Map. Price* 6*d.*

This report is accompanied by a map of the province of Kwangsi, showing the relative rank of the towns and the chief commercial products of the various regions.

China—Yunnan. *Questions Dipl. et Colon.* 7 (1899): 210–226. **Madrolle.**

A propos du Chemin de fer français au Yunnan. Iûn-Nân-Sèn, du 16 au 23 Octobre 1895. Par M. C. Madrolle. *With Map and Plans.*

Chinese Empire. **Wellby and Malcolm.**

Road Report of Route across Tibet and China. By Captain M. S. Wellby and Lieut. N. Malcolm. Simla, 1897. Size 13½ × 8½, pp. 42. *Maps.*

A note on this Report appeared in the *Journal* for March, 1898, vol. xi. p. 295.

Chinese Empire—Tibet. *B.S.G. Paris* 20 (1899): 198–213. **Bonin and Grenard.**

Les derniers Voyages dans le Tibet Oriental (MM. Holderer et Fütterer, M. et Mme. Rijnhart, M. Ch. Bonin). Par MM. C. E. Bonin et F. Grenard.

Egypt—Mount Sinai. *J. of T. Victoria I.* **31** (1899): 39–55. **Hull.**

Where is Mount Sinai? By Prof. Edward Hull, LL.D., etc. *With Map and Illustrations.*

India. *Imp. and Asiatic Quarterly Rev.* **7** (1899): 1–41. **Elliott.**

The recent Famine in India and the Reports of the Second Famine Commission. By Sir Charles Elliott, K.C.S.I., LL.D. *With Map.*

The map distinguishes those areas in which the famine was respectively intense, severe, and slight.

India. **Stein.**

Detailed Report of an Archæological Tour with the Buner Field Force. By M. A. Stein, PH.D. Lahore, 1898. Size 10 × 7, pp. 70. *Plans and Sections. Presented by the Punjab Government.*

India—Assam. **Kershaw.**

Report on the Trade between Assam and the Adjoining Foreign Countries for the Three Years ending the 31st March, 1899. By L. J. Kershaw. Shillong, 1899. Size 13 × 8½, pp. 28. *Map.*

India—Assam. *Mem. Geolog. Surv. India* **28** (1898): 71–95. **Smith.**

The Geology of the Mikir Hills in Assam. By F. H. Smith, A.R.C.S. *With Map.*

India—Bombay. *Mem. Geolog. Surv. India* **28** (1898): 27–30. **Oldham.**

A note on the Allah-bund in the north-west of the Rann of Kuchh. By R. D. Oldham, A.R.S.M., F.G.S. *With Map.*

India—Burma. *Mem. Geolog. Surv. India* **28** (1898): 30–71. **Grimes.**

Geology of parts of the Myingyan, Magwe, and Pakokku Districts, Burma. By G. E. Grimes. *With Maps.*

India—Geological Survey. **Griesbach.**

General Report on the Work carried on by the Geological Survey of India for the period from the 1st April, 1898, to the 31st March, 1899, under the direction of C. L. Griesbach. Calcutta, 1899. Size 10½ × 7, pp. 92. *Presented by the Geological Survey of India.*

AFRICA.

Bouvet Island. *Ann. Hydrographie* **27** (1899): 276–281. **Sachse.**

Die Wiederauffindung der Bouvet-Insel durch die deutsche Tiefsee-Expedition an Bord der "Valdivia." Bericht. . . . Von W. Sachse. *With Map and Plate.*

This is an account by the navigating officer of the *Valdivia* of the re-discovery of Bouvet island in the South Atlantic.

British East Africa—Pemba. **Baumann.**

Die Insel Pemba und ihre kleinen Nachbarinseln. Von Dr. Oscar Baumann.—Wissenschaftliche Veröffentlichungen des Vereins für Erdkunde zu Leipzig. Dritter Band, Drittes Heft. Leipzig: Duncker & Humblot, 1899. Size 10 × 6½, pp. 16. *Map. Presented by the Verein für Erdkunde, Leipzig.*

British South Africa. ———

British South Africa Company. Correspondence with Mr. C. J. Rhodes relating to the Proposed Extension of the Bechuanaland Railway. London: Eyre & Spottiswoode, 1899. Size 13¼ × 8½, pp. 22. *Price* 2½*d.*

Correspondence relating to the "Cape to Cairo" railway.

British South Africa. **Schlichter.**

Travels and Researches in Rhodesia. By Henry Schlichter, D.SC. From the *Geographical Journal* for April, 1899. Size 10 × 6½, pp. 22. *Map and Illustrations.*

British West Africa. **Snelson.**

Modern Bundooism and Kindred Institutions in Pagan Africa. By Rev. F. G. Snelson, M.A., etc. Second Edition. Liverpool, 1899. Size 9 × 6, pp. 16. *Presented by the Author.*

On some of the customs of the pagan natives in West Africa.

Canary Islands. **Croker.**

Trade of Canary Islands for the year 1898. Foreign Office, Annual No. 2278, 1899. Size 10 × 6½, pp. 14. *Price* 1*d.*

Central Africa—Sport. **Foà.**

After Big Game in Central Africa. Records of a Sportsman from August, 1894, to November, 1897, when crossing the Dark Continent from the Mouth of the Zambesi to the French Congo. By Edouard Foà. Translated from the French, with an Introduction by Frederic Lees. London: A. & C. Black, 1899. Size 9 × 6½, pp. xxviii. and 330. *Map and Illustrations. Price* 21*s. Presented by the Publishers.*

M. Foa killed 500 head of big game on his journey from the mouth of the Zambezi to the mouth of the Congo, and the book contains a large number of illustrations of the animals killed. An appendix gives a summary of the game laws of some of the African territories.

Congo State. **Lancaster.**

Court Aperçu du Climat du Congo. Par A. Lancaster. Bruxelles, 1899. Size 7½ × 5, pp. 44. *Sketch-map. Presented by the Author.*

Congo State. **Raikes.**

Summary of Congo Trade Returns for the year 1898. Foreign Office, Annual No. 2292, 1899. Size 10 × 6, pp. 10. *Price* 1*d.*

Egypt. *Cosmos* **12** (1894–96): 270–309, 321–355. **Revelli.**

Il Viaggio in Oriente di Vitaliano Donati (1759–1762). Ricerche e studi del Dottor Paolo Revelli.

The second part describes the journey of Donati in Egypt in detail, the earlier instalment referring mainly to biographical particulars and the journey in Eastern Europe.

Egypt. *J. of T. Victoria I.* **31** (1899): 57–71. **Walker and Dawson.**

Herodotus. I.—How far his Remarks bearing on Egyptian Geology are reliable in the Light of recent Egyptian Research. By Rev. F. A. Walker, D.D.; Sir J. W. Dawson, C.M.G., F.R.S., on the same.

Egyptian Sudan. *Cosmos* **12** (1894–96): 259–270, 363–366. ———

R. Slatin Pascià nel Sudàn Orientale, 1879–1895.

Egyptian Sudan. *B.S. Khédiv. G.* **5** (1899): 167–183. **Abbate.**

Khartoum-Omdourman et la chute du Mahdisme. Par le Dr. Abbate Pacha.

Egyptian Sudan. **Lamb.**

Trade of Suakin for the year 1898. Foreign Office, Annual No. 2247, 1899. Size 10 × 6, pp. 14. *Price* 1*d.*

Interesting particulars are given showing the gradual return of prosperity to Suakin as the port of the Sudan.

Egyptian Sudan. *P.R. Artillery I.* **26** (1899): 267–284. **Parsons.**

The Eastern Soudan. By Colonel C. S. Parsons, R.A. *With Maps.*

An account of the fighting on the Atbara and the capture of Gedarif, with a description of the portion of the Sudan between the Red Sea and the Nile.

Egyptian Sudan. **Reed.**

Fashoda and the Bahr-el-Ghazal. By J. Howard Reed. Manchester: T. Sowler & Sons, 1899. Size 8½ × 5½, pp. 60. *Illustrations. Price* 6*d. Presented by the Author.*

A short historical account of the Egyptian Sudan.

French Congo. *C.Rd. S.G. Paris* (1899): 221–222. **Béhagle.**

Haut-Oubangui. Mission de Béhagle. *With Map.*

French West Africa. *B.S.G. Paris* **20** (1899): 220–235. **Chanoine.**

Mission Voulet-Chanoine. Itinéraire du capitaine Chanoine de Dienné à Sansanné-Haoussa.

French West Africa. *B.S.G. Lille* **31** (1899): 357–368. **Chanoine.**

Mission Voulet-Chanoine. Par Capitaine Chanoine.

French West Africa. *C. Rd. S.G. Paris* (1899): 211–214. **Clozel.**

La Côte d'Ivoire. Par M. François J. Clozel.

French West Africa. *Questions Dipl. et Colon.* **7** (1899): 103–108. **Machat.**

Les Ressources économiques du Fouta-Djallon. Par J. Machat.

German East Africa. *M. Deutsch. Schutzgeb.* **12** (1899): 51–62. ———

Weitere Resultate der meteorologischen Beobachtungen im Kondeland.

German East Africa. *M. Deutsch. Schutzgeb.* **12** (1899): 105–106. **Herrmann**
Hauptmann Herrmanns Aufnahmen zwischen dem Victoria-Nyansa und dem Kagera. Von Dr. R. Kiepert. *With Map.*

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Astronomische Ortsbestimmungen, magnetische Deklinationsbestimmungen und Höhenmassungen im Kilimandjaro-Gebiet. Angestellt von Dr. Maurer.

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Resultate aus den geographischen Ortsbestimmungen des Hauptmanns Ramsay auf der Reise nach Udjidji und an diesem Orte selbst. Januar bis Juni 1897. Bearbeitet von L. Ambronn.

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Bestimmungen der geographischen Breite einer Reihe von Orten, ausgeführt von Hauptmann Ramsay auf der Tongwe-Expedition und auf einem späteren Marsche in der Zeit vom 23 August bis 13 Dez 1897. Bearbeitet von L. Ambronn und E. Grossmann.

German East Africa. *M. Deutsch. Schutzgeb.* **12** (1899): 67–105. **Richter.**
Der Bezirk Bukoba. Von Oberleutnant Richter. *With Map.*

German South-west Africa. *M. Deutsch. Schutzgeb.* **12** (1899): 41–43. **Estorff.**
Astronomische Ortsbestimmungen in Südwestafrika. Ausgeführt von Hauptmann v. Estorff. Berechnet von Astronom M. Schnauder.

German West Africa—Kamerun. *M. Deutsch. Schutzgeb.* **12** (1899): 38–40. **Moisel.**
Begleitworte zu der Karte des nördlichen Buiugebietes. Von Max Moisel. *With Map.*

German West Africa—Kamerun. *M. Deutsch. Schutzgeb.* **12** (1899): 65. ———
Regenmessungen in Debundja.

German West Africa—Kamerun. *M. Deutsch. Schutzgeb.* **12** (1899): 66. **Besser.**
Astronomische Ortsbestimmungen in Kamerun. Ausgeführt von Hauptmann v. Besser. Berechnet von M. Schnauder.

German West Africa—Togo. *M. Deutsch. Schutzgeb.* **12** (1899): 1–37. ———
Ueber das Harmattanphänomen in Togo. 1. Beobachtungen über den Harmattan von Dr. H. Gruner; 2. Bemerkungen zu den meteorologischen Beobachtungen in Bismarckburg von A. Mischlich; 3. Bemerkungen zu den meteorologischen Beobachtungen in Sugu-Wangara im Marz 1897, von Leutnant v. Seefried; 4. Schlussbemerkung von Dr. von Danckelman.

German West Africa—Togo. *Questions Dipl. et Colon.* **7** (1899): 286–292. **Hauser.**
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Marocco. **White.**
Trade of Tangier and District for the year 1898. Foreign Office, Annual No. 2296, 1899. Size 9½ × 6, pp. 22. *Price* 1½*d.*

Nigeria. ———
Niger. West African Frontier Force. Reports for 1897–98. Colonial Reports, Annual No. 260, 1899. Size 10 × 6, pp. 36. *Price* 2½*d.*

These reports contain some interesting information as to the character of the natives recruited for the West African Frontier Force.

Nigeria. **Edwards.**
The Future of the Niger. By Fredk. A. Edwards. From the *Westminster Review*, April, 1899, pp. 388–397. Size 10 × 6¾. *Presented by the Author.*

This paper deals with the progress which has been made by the Royal Niger Company and the colonial officers in opening up the country and repressing the savagery of the natives.

NORTH AMERICA.

Canada—New Brunswick. *B. Nat. Hist. S. New Brunswick* **4** (1899): 122–136. **Ganong.**
Notes on the Natural History and Physiography of New Brunswick. By W. F. Ganong, PH.D.

One of these notes points out the disadvantages which the want of a topographical survey entails on the province of New Brunswick; another deals with the mud of the frequent mud lakes. This mud far exceeds the water in depth, is composed of

microscopic siliceous plants, mainly desmids and diatoms, and is rapidly filling the lakes with deposits of siliceous earth.

Canada—New Brunswick. **Matthew and Kain.**

On Artesian and Fissure Wells in New Brunswick. By G. F. Matthew and S. W. Kain. Reprinted from *Bulletin* of the Natural History Society of New Brunswick, No. xvii., 1899. Size 9 × 6, pp. 143–152. *Presented by S. W. Kain, Esq.*

Canada—N.W.T. *Scottish G. Mag.* **15** (1899): 351–356. **Begg.**

Early Exploration in North-West Canada. By Alexander Begg.

Canada—Nova Scotia. *P. Boston S. Nat. History* **28** (1899): 375–407. **Woodman.**

Studies in the Gold-Bearing Slates of Nova Scotia. By J. Edmund Woodman. *With Map and Plates.*

Canada—Rocky Mountains. **Collie.**

Exploration in the Canadian Rockies: A search for Mount Hooker and Mount Brown. By Prof. Norman Collie, F.R.S. From the *Geographical Journal* for April, 1899. Size 10 × 6½, pp. 22. *Map and Illustrations.*

Canada—Tides. **Dawson.**

Survey of Tides and Currents in Canadian Waters. Report of Progress. By W. Bell Dawson, C.E. Ottawa, 1899. Size 10 × 6½, pp. 36. *Map and Diagrams.*

Newfoundland—Cod fishery. **Bellet.**

La pêche de la morue sur le grand banc de Terre-Neuve. Par M. A. Bellet. Congrès International de Pêches Maritimes, Comptes rendus des séances. Paris, 1899. Pp. 120–142.

Newfoundland—Historical. **Musset.**

Les Rochelais à Terre-Neuve, d'après un mémoire de M. Musset.—Congrès International de Pêches Maritimes, Comptes rendus des Séances. Paris, 1899. Pp. 150-153.

It is stated that between 1497 and 1550, out of 128 recorded voyages from Europe to the Grand Banks of Newfoundland no less than 93 were by French vessels, most of them sailing from La Rochelle.

Southern California. *J. School G.* **3** (1899): 201–212. **Chamberlain.**

Southern California. By J. F. Chamberlain. *With Illustrations.*

United States. ———

Annual Reports of the War Department for the Fiscal Year ended June 30, 1898. Report of the Chief of Engineers. 6 vols. Washington, 1898. Size 9½ × 6, pp. 3856. *Charts, Diagrams, and Illustrations. Presented by the Chief of Engineers, U.S. Army.*

United States. *Rev. G.* **44** (1899): 401–414. **Barré.**

Les États-Unis d'Amérique et leur extension en 1899. Conséquences de la guerre hispano-américaine. Par P. Barré.

United States. *Terrestrial Magnetism* **4** (1899): 93–104. **Bauer.**

The Magnetic Work of the United States Coast and Geodetic Survey. By L. A. Bauer.

United States. *J. Geology* **7** (1899): 375–388. **Hobbs.**

The Diamond Field of the Great Lakes. By W. H. Hobbs.

United States. **Porter.**

Impressions of America. By T. C. Porter. London: C. A. Pearson, 1899. Size 9 × 6, pp. xxiv. and 242. *Illustrations. Presented by the Publishers.*

An unusually interesting account of a pleasure trip to Niagara, the Yellowstone Park, California, and Colorado. The book is illustrated in an original manner by a fine series of photographic reproductions arranged in pairs for stereoscopic vision, a small stereoscope being provided for that purpose and placed in a pocket at the end of the book.

United States—Anthropology. **Hrdlicka.**

Anthropological Investigations on One Thousand White and Colored Children of Both Sexes, The Inmates of the New York Juvenile Asylum, etc. By Dr. Ales Hrdlicka. Size 9½ × 6, pp. 86. *Illustrations. Presented by the Directors of the New York Juvenile Asylum.*

CENTRAL AND SOUTH AMERICA.

Brazil. **Siemiradzki.**

La Nouvelle Pologne, état de Paraná (Brésil). Par B. Joseph de Siemiradzki. (Université Nouvelle, Institut Géographique de Bruxelles, Publication No. 1.) Bruxelles, 1899. Size 10 × 6½, pp. 12. *Map. Presented by the Institut Géographique de Bruxelles.*

Brazil—Bahia. *Rev. Trim. I.G. e Hist. Bahia* **6** (1899): 69–73. **Vasconcellos.**

Descripção da Bahia de Todos os Santos. Por Simão de Vasconcellos.

Brazil—Bahia. *Rev. Trim. I.G. e Hist. Bahia* **6** (1899): 13–25. **Lima.**

O Dique da Bahia. Pelo Dr. J. F. da Silva Lima.

Brazil—Bahia. **Nicolini.**

Trade of Bahia for the years 1896–97–98. Foreign Office, Annual No. 2282, 1899. Size 10 × 6½, pp. 20. *Price* 1½*d.*

Brazil—Bahia. *Rev. Trim. I.G. e Hist. Bahia* **6** (1899): 75–80. **Pereira.**

Noticia sobre a descoberta das Lavras Diamantinas na Bahia pelo coronel Gonçalo Pereira.

Brazil—Bahia. *Rev. Trim. I.G. e Hist. Bahia* **6** (1899): 57–68. **Praguer.**

Riqueza mineral do Estado da Bahia. VIII. O Diamante. Por Henrique Praguer.

Brazil—Geology. *B. Museu Paraense* **2** (1897): 155–204; (1898): 322–382. ——

Trabalhos restantes ineditos da Commissão Geologica do Brazil (1875–1878), relativos á geologia e geographia physica do Baixo-Amazonas.

Brazil—Parana. *L'Esplorazione Com.* **14** (1899): 33–50, 92–106, 129–142. **Tonissi.**

L. Tonissi. Progetto per un' impresa di Colonizzazione nello Stato del Paranà.

Brazil—Pernambuco. **Howard.**

Trade of Pernambuco and District for the year 1898. Foreign Office, Annual No. 2288, 1899. Size 9½ × 6, pp. 26. *Price* 2*d.*

Contains tables of monthly rainfall at Pernambuco for the ten years 1889–1898. Most rain falls in May and June, least between October and January, but the totals are subject to remarkable variations. The total annual rainfall of 1895 was 116 inches, that of 1898 only 52 inches.

Brazil—Plants. *B. Museu Paraense* **2** (1898): 288–321. **Huber.**

Materiaes para a flora amazonica. Pelo Dr. J. Huber. *With Plates.*

Brazil—Rio. *B. Museu Paraense* **2** (1898): 382–385. **Huber.**

O "Muricy" da Serra dos Orgãos. Pelo Dr. J. Huber.

Brazil—Rio de Janeiro. **Rhind.**

Trade of Rio de Janeiro for the year 1898. Foreign Office, Annual No. 2284, 1899. Size 10 × 6½, pp. 44. *Price* 2½*d.*

Brazil—Santarem. *B. Museu Paraense* **2** (1897): 78–96. **Katzer.**

A boz do Tapajós e suas relações com a agua subterranea na região de Santarem. Pelo Dr. Friederich Katzer. *With Map, Plan, &c.*

Chile. *Verh. Ges. Erdk. Berlin* **26** (1899): 265–270. **Krüger.**

Herr Dr. Paul Krüger über die Erforschung des Rio Yelcho oder Futaleufu in West-Patagonien.

Chile—Valparaiso. **Cusack-Smith.**

Trade of Valparaiso and District for the year 1898. Foreign Office, Annual No. 2287, 1899. Size 10 × 6½, pp. 30. *Price* 2*d.*

Consular reports usually complain that British firms will not issue price lists and circulars in native languages; this report mentions, as a hopeful exception, that a Doncaster firm is circulating its lists throughout Chile in Spanish.

Curaçoa. **Jesurun**

Trade of Curaçoa and Dependencies for the year 1898. Foreign Office, Annual No. 2244, 1899. Size 10 × 6, pp. 28. *Price* 2*d.*

Ecuador—Guayaquil. **Chambers.**

Trade of Guayaquil for the year 1898. Foreign Office, Annual No. 2246, 1899. Size 10 × 6, pp. 12. *Price* 1*d.*

Nicaragua. *National G. Mag.* **10** (1899): 247–266. **Davis.**

Nicaragua and the Isthmian Routes. By A. P. Davis. *With Illustrations.*

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Physiography of the Nicaragua Canal Route. By C. Willard Hayes. *With Maps and Illustrations.*

Nicaragua Canal. *B.S.G. Madrid* **41** (1899): 84–123. **Llopis.**
Estudios sobre el Canal de Nicaragua. Por D. Arturo Llopis. *With Map.*

Paraguay. **Croskey.**
Trade of Paraguay for the year 1898. Foreign Office, Annual No. 2275, 1899. Size 10 × 6½, pp. 12. *Price* 1*d.*

Paraguay. *B.S.G. Madrid* **41** (1899): 7–22. **Jove.**
La República del Paraguay. Por D. Manuel G. Jove.

AUSTRALASIA AND PACIFIC ISLANDS.

Australia—Oceanography. *Rep. Australasian Assoc.* **7** (1898): 687–701. **Fowler.**
A Contribution to Australian Oceanography. By Thos. Walker Fowler.

Central Australia. *Rep. Australasian Assoc.* **7** (1898): 682–686. **Tietkens.**
Remarks on Central Australia, suggesting Further Exploration. By W. H. Tietkens.

German New Guinea. *M. Deutsch. Schutzgeb.* **12** (1899): 107–118. **Hahl.**
Der Bismarck-Archipel und die Salomons-Inseln. Von Assessor Dr. A. Hahl.

New Caledonia. **Erskine.**
Trade of New Caledonia for the year 1898. Foreign Office, Annual No. 2300, 1899. Size 10 × 6½, pp. 14. *Price* 1*d.*

New Guinea. *P.R.S. Queensland* **14** (1899): 14–20. **Bailey.**
Notes on the Vegetation of New Guinea. By F. Manson Bailey.
From observations made during a visit with Lord Lamington, the Governor of Queensland.

New Guinea. *Rep. Australasian Assoc.* **7** (1898): 712–722. **McClymont.**
The Discovery of New Guinea by Antonio D'Abreu. By J. R. McClymont, M.A. *With Map.*

New South Wales. ———
New South Wales Statistical Register for 1897 and Previous Years. Sydney, 1898. Size 10 × 6½, pp. viii. and 902. *Map. Presented by the Agent-General for New South Wales.*

New South Wales. **Campbell.**
Memoirs of the Geological Survey of New South Wales. Ethnological Series. No. 1. Aboriginal Carvings of Port Jackson and Broken Bay: measured and described by W. D. Campbell, A.K.C., etc. Sydney, 1899. Size 12½ × 10, pp. 74. *Map and Plates. Presented by the Survey.*

New South Wales. *Rep. Australasian Assoc.* **7** (1898): 176–237. **Furber.**
The Trigonometrical Survey of New South Wales, with mention of Similar Surveys in the other Colonies. By T. F. Furber. *With Maps and Plans.*
Describes the primary triangulation of New South Wales, with maps and diagrams, and gives maps also showing the extent of triangulations in Australia, and the position of stations in New South Wales and Queensland the latitude and longitude of which have been accurately determined.

New South Wales. **Watt.**
New South Wales. Mineral Resources, No. 5. Report on the Wyalong Gold-Field. By J. A. Watt, M.A., etc. Sydney, 1899. Size 10 × 6½, pp. 40. *Map. Presented by the Geological Survey of New South Wales.*

New South Wales—Meteorology. **Russell.**
Results of Rain, River, and Evaporation Observations made in New South Wales during 1897. By H. C. Russell, B.A., etc. Sidney, 1898. Size 9½ × 6, pp. lxiv. and 220. *Map and Diagrams. Price* 3*s.* 6*d. Presented by the Author.*

New Zealand. ———
Statistics of the Colony of New Zealand for the Year 1897: with statistics of Local Governing Bodies for the year ended 31st March, 1898. Wellington, 1898. Size 13½ × 8½, pp. xvi. and 510.

New Zealand. *P.I. Civil Engineers* **136** (1899): 265–267. **Rawson.**

Westport Harbour, New Zealand.—Wave Basin. By T. H. Rawson. *With Plan.*

This short paper describes and figures the method employed for protecting the chief coal-exporting harbour of New Zealand from the effects of a heavy sea entering a narrow river, which runs in at right angles to the coast, facing the prevailing wind.

Queensland. **Dunstan.**

Report on the Mesozoic Coal Measures of Stanwell and associated formations. By B. Dunstan. Brisbane, 1898. Size 13 × 8½, pp. 22. *Maps and Illustrations. Presented by the Queensland Government.*

Queensland—Brisbane River. *P.I. Civil Engineers* **136** (1899): 268–281. **Williams.**

Floods in the Brisbane River; and a System of Predicting their Heights and Times. By C. J. R. Williams. *With Map and Diagram.*

Includes a sketch-map of the basin of the Brisbane river, showing the position of the various flood-gauges.

Samoa. *National G. Mag.* **10** (1899): 218–220. **Austin.**

The Commercial Importance of Samoa. By O. P. Austin.

Samoa. *Ann. G.* **8** (1899): 369–373. **Bellet.**

La valeur économique de Samoa. Par M. D. Bellet.

Samoa. *Globus* **76** (1899): 4–13. **Reinecke.**

Zur Kennzeichnung der Verhältnisse auf den Samoa-Inseln. Von Dr. Reinecke. *With Illustrations.*

Samoa. *National G. Mag.* **10** (1899): 207–217. **Webster.**

Samoa: Navigators Islands. By Commander H. Webster. *With Illustrations.*

POLAR REGIONS.

Arctic—Bear Island. *Ymer* **19** (1899): 171–185. **Nathorst.**

Några upplysningar till den nya Kartan öfver Beeren Eiland. Af A. G. Nathorst. *With Maps and Illustrations.*

A new map of Bear island, with notes upon it.

MATHEMATICAL GEOGRAPHY.

Height Measurement. **Mohn.**

Videnskabsselsk. Skrifter, Christiania (1899, No. 2): 1–70.

Das Hypsometer als Luftdruckmesser und seine Anwendung zur Bestimmung der Schwerekorrektion. Von H. Mohn.

Latitude Determinations. **Cattolica.**

Stazione Astronomica a San Cataldo di Bari eseguita da Pasquale Leonardi Cattolica. Campagna Idrografica dello "Scilla," 1898. Genoa, 1899. Size 12½ × 9, pp. 50. *Plates. Presented by the Italian Hydrographic Office.*

On the determination of the absolute azimuth and the latitude of San Cataldo di Bari, with tables of observations and an illustrated description of instruments and methods.

Nautical Almanac. ———

The American Ephemeris and Nautical Almanac for the year 1901. First Edition. Washington, 1899. Size 11 × 7½, pp. 632. *Diagram.*

Time. **Hayden.**

Clock-Rates and Barometric Pressure as illustrated by the Mean-Time Clock and three Chronometers at Mare Island Observatory, with a brief account of the Observatory. By Ensign Everett Hayden. [Reprinted from *Publications of the Astronomical Society of the Pacific*, No. 68.] San Francisco, 1899. Size 9 × 6, pp. 101–114. *Diagrams. Presented by the Author.*

The astronomically regulated clock at Mare Island Observatory is the standard for rating chronometers at all the ports of the Pacific states, to which the beats of its pendulum are transmitted electrically for five minutes daily in an audible manner.

Time reckoning. *J. School G.* **3** (1899): 168–172. **Holmes.**

Where does the Day begin? By F. H. Holmes.

On the date-line in the Pacific ocean.

Units of Measurement. **Warren.**

Palestine Exploration Fund, Quarterly Statement (1899): 218–268.

The Ancient Standards of Measure in the East. By Lieut.-General Sir Charles Warren, K.C.B., F.R.S.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geomorphology. **Gregory.**

The Plan of the Earth and its Causes. By J. W. Gregory, D.Sc. From the *Geographical Journal* for March, 1899. Size 10 × 6½, pp. 225–251.

Geophysics. *J. of T. Victoria I.* **31** (1899): 11–37. **Kelvin.**

The Age of the Earth as an Abode fitted for Life. By the Right Hon. Lord Kelvin. [Annual Address.]

Geophysics. *Science* **9** (1899): 889–901: 10 (1899): 11–18. **Chamberlin.**

Lord Kelvin's Address on the Age of the Earth as an Abode fitted for Life. By Prof. T. C. Chamberlin

Criticism of Lord Kelvin's address.

Meteorology. **Berry.**

Proceedings of the Convention of Weather Bureau Officials, held at Omaha, Nebr., October 13–14, 1898. Edited by James Berry. Bulletin No. 24, U.S. Department of Agriculture. Weather Bureau, Washington, 1899. Size 9 × 6, pp. 184. *Plate.*

Meteorology. *Symons's Monthly Meteorolog. Mag.* **34** (1899): 81–86. ——

Meteorological Extremes—Pressure.

The highest authentic reading of atmospheric pressure reduced to sea-level was 31·780 inches at Irkutsk in 1893; the highest in Europe, 31·108 at Ochtertyre in 1896; the highest in America, 31·420 at Swift Current on the Canadian Pacific Railway. The lowest ever observed on land was 27·124 in Orissa in 1885, and the lowest in Europe 27·332 at Ochtertyre. A reading of 27·04 was recorded at sea in the heart of a West Indian hurricane.

Meteorology—Clouds. **Henry.**

U.S. Dep. Agriculture, Monthly Weather Rev. **27** (1899); 57–58.

Wave or billow clouds. By A. J. Henry. *Plates.*

Meteorology—Hygrometry. **Lancaster.**

De la manière d'utiliser les observations hygrométriques. Par A. Lancaster. Rapport lu au V^e^ Congrès international d'Hydrologie, de Climatologie et de Géologie médicales de Liége, 1898. Liége, 1899. Size 9½ × 6½, pp. 14. *Presented by the Author.*

Meteorology—Instruments. ——

The Baro-cyclono-meter. Manila, 1898. Size 9½ × 7, pp. 8. *Illustration and Diagrams. Presented by the Manila Observatory.*

This instrument is devised in order to predict cyclones in Eastern seas with greater certainty than has hitherto been possible for an isolated observer.

Meteorology—Rainfall. **Black.**

Ocean Rainfall by Rain-Gauge Observations at Sea. General, and Special Oceans. By W. G. Black. 1864–75–81. Edinburgh: E. & S. Livingstone. Size 9½ × 6½, pp. 16. *Diagrams. Presented by the Author.*

Ocean Currents. **Russell.**

Current Papers, No. 3. By H. C. Russell, B.A., etc. [Read before the Royal Society of N.S. Wales, October 5, 1898.] Reprinted from *Journal and Proceedings of the Royal Society of N.S. Wales*, vol. xxxii. Size 9 × 6, pp. 12. *Maps. Presented by the Author.*

Ocean Depths. ——

List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1898, from H.M. Surveying Ships, Indian Marine Survey, and British Submarine Telegraph Companies. London: J. D. Potter, 1899. Size 13½ × 8½, pp. 26. *Price 4s.*

Ocean-floor. **Hull.**

On the Sub-Oceanic Physical Features off the Coast of Western Europe, including France, Spain, and Portugal. By Prof. Edward Hull, LL.D., F.R.S. From the *Geographical Journal* for March, 1899. Size 10 × 6½, pp. 10. *Map.*

Oceanography. **Hector.**

Australasian Association for the Advancement of Science. Sydney Session, 1898. Section E—Geography. Presidential Address by Sir James Hector, K.C.M.G., etc. Size 8½ × 5½, pp. 8. *Map. Presented by the Author.*

The address deals mainly with submarine geography.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Historical—Cabot. **Harrisse.**

The Cabots. Notes on certain Papers contributed to the Transactions of this Society. By Henry Harrisse. From the *Transactions of the Royal Society of Canada.* Second Series, 1898–99, vol. iv., section II. Ottawa: J. Hope & Sons, 1898. Size 10 × 7, pp. 103–106.

Historical—Hanno. **Illing.**

Der Periplus des Hanno. Von Dr. Karl Emil Illing. Dresden, 1899. Size 10 × 8½, pp. 50.

Historical—Magellan. **Alberto.**

Gaetano Alberto. Descobrimento das Filippinas pelo navegador Portuguez Fernão de Magalhães. Lisboa, 1898. Size 8 × 5½, pp. 148. *Illustrations. Presented by the Author.*

Historical—Marco Polo. **Nordenskjöld.**

The Influence of the 'Travels of Marco Polo' on Jacobo Gastaldi's Maps of Asia. By Baron A. E. Nordenskjöld. From the *Geographical Journal* for April, 1899. Size 10 × 6½, pp. 12.

Political Geography. *G. Tidskrift* **15** (1899): 22–29. **Elberling.**

Ændringer i den politiske Geografi i den sidste snes aar. Af Rigsdags-Bibliothekar Emil Elberling.

On recent changes in political geography.

Political Geography. *National G. Mag.* **10** (1899): 185–206. **McGee.**

National Growth and National Character. By W. J. McGee.

An address to the National Geographic Society on March 28, 1899, as a summary of a course of lectures on the territorial growth of the United States.

Tropical Colonization. *Kolon. Jahrb.* **11** (1899): 213–240. **Meinecke.**

Siedelung in den Tropen. Eine Mahnung und Warnung. Von G. Meinecke.

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Contains a portrait of the late Prof. Veth, a list of his writings, and the catalogue of his extensive library of Oriental and geographical works.

Bibliography. *Science* **9** (1899): 761–771, 799–808. **Adler.**

The International Catalogue of Scientific Literature.—Second Conference. By Cyrus Adler.

A full report by the American delegate of the second conference held by the Royal Society to consider an International Catalogue of Scientific Literature. It was decided at that conference to consider mathematical and physical geography alone in the proposed catalogue, ignoring the general science of geography.

Bibliography. **Boutwell.**

Bibliography of Geographical Works published in the United States in 1898. By J. M. Boutwell.—Bull. American Geographical Society, vol. xxxi., 1899, No. 3. Size 9½ × 6, pp. 16. *Presented by the Compiler.*

Bibliography. *Science* **9** (1899): 825–835. **Carus.**

On the International Catalogue of Scientific Literature of the Royal Society. By Prof. J. Victor Carus.

A criticism of the conclusions of the second conference, based on Dr. Adler's report.

Bibliography. **Knox.**

Geographical Index (Extra-European) to Books, Periodicals, etc. Compiled in the Intelligence Division, War Office, by Alexander Knox, B.A., Map Curator. 1898. London: Harrison & Sons. Size 11 × 7½, pp. xvi. and 114. *Presented by the Intelligence Division, War Office.*

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The International Catalogue of Scientific Literature. Geology and Geography, by Prof. N. S. Shaler.

Educational. **Brigham.**

Physical Geography in Secondary Schools. By Prof. A. P. Brigham. Reprinted from the *Proceedings of the National Educational Association*, 1897. Size 9 × 6, pp. 924–928. *Presented by the Author.*

Geographical Discovery. *Rep. Australasian Assoc.* **7** (1898): 672–682. **Macdonald.**

Sixty Years' Progress of Geographical Discovery (1837–1897). By A. C. Macdonald.

Geographical Exhibition. *J. School G.* **3** (1899): 216–222. **Dodge.**

The Geographical and Geological Exhibition at Springfield, Mass. By Richard E. Dodge.

Geographical Orthography. *J. School G.* **3** (1899): 161–167. **Chisholm.**

Notes on the Spelling of some Common Geographical Names; given in No. 9, vol. ii. of the *Journal*. By G. G. Chisholm.

Geographical Progress. *B.S.G. Lyon* **15** (1899): 609–645. **Groffier.**

Travaux géographiques des missionnaires catholiques en 1898. Par M. V. Groffier.

German Colonies.

Jahresbericht der Deutschen Kolonialgesellschaft, 1898. Berlin, 1899. Size 9½ × 6½, pp. 60.

German Colonies—Bibliography. *Kolon. Jahrb.* **11** (1899): 278–304. **Brose.**

Die deutsche Kolonialliteratur im Jahre 1897, zusammengestellt von Maximilian Brose.

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

EUROPE.

England and Wales. **Ordnance Survey.**

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(*E. Stanford, Agent.*)

England and Wales. **Johnston.**

W. & A. K. Johnston's "Three Miles to Inch" Map of England. Scale 1: 190,080 or 3 stat. miles to an inch. W. & A. K. Johnston, Edinburgh and London, 1899. Sheets 1, 2, 3, 19, 20, 21, 24, 25. *Presented by the Publishers.*

The principal feature in this map is the manner in which all the main roads are distinguished by being coloured brown. Some heights above sea-level are given in figures, but there is no hill shading.

Glasgow. **Bartholomew.**

Cyclist's Road Map of Glasgow District. Scale 1: 126,720 or 2 stat. miles to an inch. J. Bartholomew & Co., Edinburgh, 1899. *Price* 1s., mounted on cloth. *Presented by J. Bartholomew & Co.*

Historical Atlas. **Poole.**

Historical Atlas of Modern Europe from the Decline of the Roman Empire; comprising also maps of parts of Asia and of the New World connected with European History. Edited by Reginald Lane Poole, M.A., PH.D., Fellow of Magdalen College, and Lecturer in Diplomatic in the University of Oxford. Part xxiii. Oxford: The Clarendon Press; London, Edinburgh, Glasgow, and New York: Henry Frowde, M.A.; Edinburgh: W. & A. K. Johnston. 1899. *Price* 3s. 6d. *Presented by the Clarendon Press.*

Part xxiii. contains maps No. 38, 39, Germany, during the period of the Reformation and the Thirty Years' War, by the Rev. J. P. Whitney, M.A.; No. 81, Western Asia under the Turks and Persians, by Prof. S. Lane Pole, M.A. These maps are accompanied by explanatory letterpress.

Plymouth and Neighbourhood. **Bartholomew.**

Plan of Plymouth, Devonport, Stonehouse, and neighbourhood. Scale 6 inches to a mile. By J. Bartholomew, F.R.G.S. London: W. H. Smith & Sons, 1899. *Price* 2s., *mounted on cloth. Presented by J. Bartholomew & Co.*

ASIA.

Korea. **Japanese Government.**

Map of Korea and the neighbouring parts of China. Scale 1: 1,000,000 or 15·8 stat. miles to an inch. From Japanese Government Surveys. 10 sheets. *Presented by the Japanese Government.*

This is a Japanese map of Korea and neighbouring parts of China, the lettering being in Chinese character.

AFRICA.

Transvaal. **Johnston.**

Map of the Transvaal, or South African Republic, and surrounding countries. Scale 1 : 1,900,800 or 30 stat. miles to an inch. W. & A. K. Johnston, Edinburgh and London. *Presented by the Publishers.*

AMERICA.

Canada. **Surveyor-General of Canada.**

General Map of the North-Western Part of the Dominion of Canada. Scale 1 : 2,217,400 or 35 stat. miles to an inch. Topographical Surveys Branch, Department of the Interior, Ottawa, 1898. *Presented by the Surveyor-General of Canada.*

This map has been compiled from observations and surveys by the Topographical Branch of the Department of the Interior, maps of the International Boundary Survey, maps of the Exploratory surveys by the Geological Survey Department, Admiralty Charts of the Polar Regions, general chart of Alaska by the United States Coast Survey, official maps of British Columbia, and other authentic sources. The region which this map includes is one of special interest at the present time, partly in connection with the Alaskan boundary dispute, and also in connection with the gold-mining industry. An inset map of the whole of the Canadian Dominion is given, showing the approximate areas of the different provinces.

AUSTRALIA.

Queensland. **Jack.**

Geological Map of Queensland. Scale 1 : 1,013,760 or 16 stat. miles to an inch. Compiled by Robert L. Jack, F.G.S., F.R.G.S., Govt. Geologist, 1899. Surveyor-General's Department, Brisbane. 6 sheets.

All persons interested in the geology and mining industry of Queensland will find this an interesting map. It appears to have been very carefully prepared, all the most recent and reliable material having been used in its compilation.

GENERAL.

World. **Meyer.**

Meyer's Hand-Atlas. Zweite, neubearbeitete und vermehrte Auflage mit 112 Kartenblättern, 9 Textbeilagen und Register aller auf den Karten verzeichneten Namen. Parts 17 to 20. Leipzig und Wien. Verlag des Bibliographischen Instituts, 1899. *Price 30 pf. each part.*

CHARTS.

Pacific Ocean. **The Indiarubber, Gutta-percha, and Telegraph Works Co.**

Charts of the Pacific Ocean. Compiled from Admiralty Surveys and other Official Sources by the Indiarubber, Gutta-percha, and Telegraph Works Co., Silvertown. J. D. Potter, London, 1899. *Presented by M. H. Gray, Esq.*

This chart has been compiled from the Admiralty surveys and other official sources by the Indiarubber, Gutta-percha, and Telegraph Works Co. As many soundings as possible along the route of the proposed Pacific Cable have been given, the intention being to show on one chart what could otherwise only be seen on several. Owing to the want of space, many deep-sea soundings south of the Sandwich islands have had to be omitted, but those shown give a fair general idea of the depth. All the deepest soundings are marked.

United States Charts. **U.S. Hydrographic Office.**

Pilot Charts of the North Pacific Ocean for August and September, 1899, and of the North Atlantic Ocean for August, 1899. Published at the Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Caucasus. **Déchy.**

Seventy-seven Photographs of the Caucasus, by M. Maurice de Déchy, 1897–98. *Presented by Mon. Maurice de Déchy.*

This set of photographs is a further contribution from M. Déchy, who has already presented the Society with numerous photographs of the Caucasus. Most of them are remarkably good specimens. The following is a list of the subjects:—

(1) Glacier on the north side below the Klukhor pass, Western Caucasus; (2) View from the Klukhor pass towards the south; (3) Mountains of the Klukhor group, seen

from the north side below the Klukhor pass; (4) Klukhor group: the Dombai-ulgen glacier; (5) Klukhor group: Alibek mountains and glacier, from the Amanaus valley; (6) Glaciers descending into the Amanaus valley; (7) The Klukhor group from the upper Teberda valley; (8) In the Teberda valley: view of Klukhor group, Belalakaja and Amanaus glaciers; (9) Belalakaja, from the Amanaus valley; (10) Klukhor group, seen from the rest-house on the north side of the Klukhor pass; (11) Ice lake on the Klukhor pass; (12) View from the upper Klush valley; (13) Daghestan, the valley above Khonokh, Eastern Caucasus; (14) The Botshokh glacier, Daghestan; (15) Lake Kesenoi-am, Daghestan; (16) Bogos group from the range north of Aknada, Daghestan; (17) Village of Konada, Daghestan; (18) Western part of Bogos group, seen from south of Tindi, Daghestan; (19) Village of Aknada, Daghestan; (20) Village of Tindi, Daghestan; (21) Glaciers on the south side of the Klukhor pass; (22) On the way to the Gandarar pass; (23) View towards the south-east, from the Gandarar pass; (24) Elbrus seen from the slopes below the Chirikol pass; (25) In the Chirikol valley (side valley of the Ullukam); (26) The Chirikol glacier; (27) Ullukam valley; (28) Near Khursuk; (29) View towards the south from the Chirikol pass; (30) Shatil, village in the upper Argun valley, Eastern Caucasus; (31) Gorges of the Argun above Shatil; (32) Gorges of the Argun above Shatil; (33) View from the Kachulam pass; (34) View towards the south from the Kachulam pass; (35) The upper top ridge of Datakh-Kort; (36) Sharoi, Eastern Caucasus; (37) Camp in the upper Khonokh valley, Daghestan; (38) Camp below Kachu pass; (39) Karachai, from Uchkulan; (40) Gorge at junction of Tekho river with the Andiski-Koissu, Daghestan; (41) Gorges of Andiski-Koissu, Southern Daghestan; (42) Saltinski-Most (bridge), Tekho river, Daghestan; (43) The Khonokh glacier, Daghestan; (44) Leshgian of Tindi; (45) Group of Leshgians at the top of the house of the Naib of Tindi, Daghestan; (46) Escort in 1898, the Naib of Tindi at the head; (47) Karachai from the Uchkulan valley; (48) Karachai of Khursukh; (49) Chechen boys in woods near the Khonischali huts; (50) Chechen woman with child; (51) Leshgian woman from the Andiski-Koissu valley; (52) Kistians in the upper Alazan valley; (53) Leshgians from Konada village; (54) Donos mountain and glacier (north side), Eastern Caucasus; (55) Gorge of Sabakenis, Khevi river, Southern Daghestan; (56) Tushi, from upper Perikitelian Alazan valley; (57) Donos glacier, Perikitelian chain (north side); (58) Khargabe valley, Perikitelian chain (north side); (59) Glaciers, Perikitelian chain (north side); (60) Khulundoi village (Diklos mountains); (61) Datakh-Kort, highest summit Perikitelian chain (north side); (62) On the Kachu glacier, north side of Perikitelian chain; (63) Datakh glacier, Perikitelian chain (north side); (64) Parsma: village in the valley of the Perikitelian Alazan; (65) Upper valley of the Perikitelian Alazan; (66) Side valley of Perikitelian Alazan; (67) Chain of the Amigo Tave, seen from the Adzunta pass; (68) Tebulos mountain, seen from the upper green slopes on the north side of the Adzunta pass; (69) Gorge of the Kharokis-Skali, near Muzo (Argun river system); (70) View towards the east (Tebulos group), from the Anatoris pass; (71) Kachu glacier, Perikitelian chain (north side); (72) North side of Perikitelian chain, from a corner on entering the Donoilam valley; (73) Selis mountain, from the west slope below the Shibe pass, Khevsurian alps; (74) Khevsurians from village of Shatil; (75) Khevsurians from village of Guri; (76) Sunni Leshgians from Echeda village, Andiski-Koissu valley; (77) No title.

Hungary. **Geographical Institute of the Royal Hungarian University.**

213 Photographs of Hungary, taken by the Geographical Institute of the Royal Hungarian University, Budapest. *Presented by the Geographical Institute of the Royal Hungarian University.*

As will be seen by the following list, this is a very complete and interesting set of photographs taken in Hungary:—

(1) View of Budapest; (2) Block of travertine near Budapest; (3) Cave at the foot of the Gellerthgi, Budapest; (4 and 5) Quarries, Kis-Gellerthgi, Budapest; (6) Lake in park of Budapest; (7) Hot spring of O'Buda, from which the water was led in Roman times to Acquincum; (8) Excavations of Acquincum, near Budapest; (9) Limestone quarries, Budapest; (10 to 12) Limestone quarries at Bia, county of Pest; (13) Limestone quarries at Sóskút, Teher; (14 and 15) Quarries and concentric layers of andesite, county of Pest; (16) Andesite-conglomerate at Pomaz, county of Pest; (17) Ruins of Visegrad Castle, near Budapest; (18 and 19) Gorge of the Danube between Visegrad and Nagy-Maros; (20) Torrent in loess and red clay, Nagy-Maros, county of Hont; (21) Szokola-Huta, county of Hont; (22) Vichne, county of Bars; (23 to 25) Old landslips at Vichne; (26) Ruins of old castle at Nográd; (27) Gorge of Szádelo, county of Abaúj-Torna; (28) Sugar-loaf rock, county of Abaúj-Torna; (29) Arm of the Danube at Dömsöd, county of Pest; (30) Poplar trees at Dömsöd; (31 and 32) Shifting sand, Vadkert, county of Pest; (33) Diluvial loess at Szabadka, county of

Báos-Bodrog; (34) Peasant house with a stork's nest, Domsod; (35) Shed at Puszta-Apaj, county of Pest; (36) Cattle at Puszta-Apaj; (37) Wooden bridge over the Tisza at Zenta, county of Bács-Bodrog; (38) Old oaks on the Alföld at Tamásda, county of Bihar; (40) Roman mound near Deliblat, county of Temes; (41) Town Hall and park, Arad; (42) Park at Kis-Teno, county of Arad; (43) Torrent at Paulis, county of Arad; (44) Artesian well at Elek, county of Arad; (45) Farm at Kis-Feno, county of Arad; (46) View looking towards plains of the Alföld, Radna; (47) Mária-Radna, with church and monastery, county of Arad; (48) Gorge of Solymos, county of Arad; (49) Royal school of viticulture, Ménes, county of Arad; (50 and 51) Andesite-conglomerates, county of Arad; (52) Spheroidal Diabas, county of Arad; (53) Katravotron, called Cimpanyászka, near Vaskoh, county of Bihar; (54 and 55) Spheroidal basalt, Lukarecz, county of Témes; (56 to 58) Hungarian types from Pécska, county of Arad; (59) Flour mill near Szlatina, county of Arad; (60 to 63) Roumanian types, county of Arad; (64) Town of Vajda-Hunyad; (65) Market-place of Vajda-Hunyad; (66) View of the Retyezát mountains from the north, county of Hunyad; (67) Sunrise in the Retyezát; (68) Rock scenery on the Steveiü peak, county of Arad; (69) Lake Bukura with the Steveiü peak, Retyezát mountains; (70 and 71) Lake Zenoga, Retyezát mountains; (72) Pelaga peak with Lake Pelaga, Retyezát mountains; (73) Outflow of the Pelaga; (74) Water-percolation in rock in bed of the Lepusuyik river near Malomviz, county of Hunyad; (75) Old church of Boldogfalva, county of Hunyad; (76) Ruins of Ulpia Trajana, county of Hunyad; (77) Greek Oriental Catholic Church, Demsus, county of Hunyad; (78) Quarries in iron ore, Gyalár, county of Hunyad; (79) Wooden cross and chapel at Gyalár, county of Hunyad; (80 and 81) Mundra peak, Paring mountains, county of Hunyad; (82) Northern slope of the Paring mountains; (83) Transylvanian gold-mining district, county of Hunyad; (84) Limestone cliff, Strimba, near Körösbánya, county of Hunyad; (85) Szekeremb, county of Hunyad; (86 and 87) Barsa gold-mine, near Ruda, county of Hunyad; (88) Csetrás Boicza and Nagyág mountains, county of Hunyad; (89) Town of Boicza; (90) Trachyte dome near Boicza; (91) Landslip near Boicza; (92) Landslip at Krecsunyesd, near Boicza; (93) Holes in hard trachyte at Kristyor, county of Hunyad; (94) Landscape near Boicza; (95) Town of Déva, on the Maros, county of Hunyad; (96 and 97) Volcanic cone at Déva; (98 to 102) Summit of Mount Vulkan, counties of Hunyad and Alsó-Fehér; (103) Waterfall near the village of Vulkan, county of Hunyad; (104) Northern slope of Mount Vulkan, county of Alsó-Fehér; (105) Town of Abrudbánya, chief place of the gold-mining district of Transylvania, county of Alsó-Fehér; (106) Mining village of Yzbita, county of Alsó-Fehér; (107) Vulkoj gold-mine, county of Alsó-Fehér; (108) House of rich Roumanian gold-miner, Bucsum-Yzbita; (109) Gold-stamping mill at Vulkoj; (110) Native gold-stamping mill, Verespatak, county of Alsó-Fehér; (111 to 113) Detunata basalt cones, Bucsum; (114) Torda gorge, county of Torda-Aranyos; (115 to 118) Lake Gyilkostó, county of Csik; (119 and 120) Egyeskö peak, Nagy-Hagymás range, county of Csik; (121) Detritus cones in torrents of the Öcsémtetö, county of Csik; (122) Alpine huts at Fehérmezö, Nagy-Hagymas mountains; (123) Scenery near Zsédánypatak, county of Csik; (124) Large jurassic block, Zsedánypatak; (125) Greek Oriental Catholic church, Zsédánypatak; (126 and 127) Crater lake of Szt Anna, near Tusnád, county of Csik; (128) Entrance of the cave of Torja, county of Háromszék; (129 and 130) Travertine walls, Borszek, county of Csik; (131 and 132) Weathered rock salt, Szováta, county of Maros-Torda; (133) Salt rock with cave, Parajd, county of Udvarhely; (134) Greek Oriental Catholic church, Magyar-Gorbó, county of Kolozes; (135) Entrance to natural tunnel of a brook near Kapriora, county of Kassó-Szörény; (136 and 137) Entrance of gorge of Kazan, near Orsova, Lower Danube; (138) Landscape in Dalmatia between Spalato and Trau; (139) Abbey of Zircz, county of Veszprém; (140) Town of Veszprém; (141) Volcanic hills of Badacsony, Szigliget, Gulácshegy, etc., county of Zala; (142) Basalt cone of Badacsony, with vineyards, Lake Balaton; (143 to 145) Columnar and tabular basalt on the northern slope of the Badacsony; (146 to 151) Basaltic cone of Szent-György, near Lake Balaton; (152 to 154) The basaltic cone of Gyulakeszi, with the ruins of the castle Csobáncz, near Lake Balaton; (155) Basaltic cone of Hegyestü, Zanka, near Lake Balaton; (156) Basaltic cone of Gulácshegy, near Lake Balaton; (157 and 158) Basaltic cone, Tóthihegy, near Lake Balaton; (159) Volcanic cone of Haláphegy, near Tapolcza, county of Zala; (160) In the woods of the dolomite hills, near Keszthely, county of Zala; (161) Basaltic hill of Szigliget, Lake Balaton; (162) Warm lake at Tapolcza; (163 to 168) Village and abbey of Tihany, Lake Balaton; (169) Barátlakások caves on east side of Tihany; (170) Interior of old monks' dwellings, Tihany Peninsula; (171) Western side of Tihany peninsula, Lake Balaton; (172) Landslip, western side of Tihany peninsula; (173) Narrowest part of Lake Balaton; (174) Old Avorian mound, Tihany peninsula; (175) Landslip, western side of Tihany peninsula; (176) Sinter cones, Tihany peninsula; (177) Old geyser cone, Tihany peninsula; (178 and 179) Eastern shore of Lake

Balatan, county of Veszprém; (180 and 181) Landslip on eastern shore of Lake Balaton; (182) Port of Kenese, Lake Balaton; (183) Cave-dwelling family on eastern shore of Lake Balaton; (184) Almadi, Lake Balaton; (185) Petroleum motor-boat of the Balaton Committee of the Hungarian Geographical Society; (186) Village of Alsó-Eörs, Lake Balaton, county of Zala; (187) Portal of the old church at Telsö Eörs; (188 and 189) Villa in vineyards of Csopak, Lake Balaton; (190) Balaton-Füred, Lake Balaton; (191) Bath-house of Balaton Füred; (192) Ruins of old church near Aszófö, Lake Balaton; (193) Dry valley in triassic limestone near Dörgicse, county of Zala; (194) Curious sandstone formation at Kövágó-Eörs, county of Zala; (195) On the road to Tapolcza, county of Zala; (196) Peninsula of Szt. Mihály, Lake Balaton; (197) Ancient shore of Lake Balaton, county of Zala; (198) Ancient cliffs on the shore of Lake at Meszesgyörök; (199) Keszthely, Lake Balaton; (200 and 201) Warm lake, Hérviz, county of Zala; (202) "Scarecrow" in vineyards, Lake Balaton; (203) Yacht on Lake Balaton; (204 and 205) Limnograph apparatus, Lake Balaton; (206) Lake Balaton frozen over; (207 and 208) On the ice, Lake Balaton, in the winter 1892-93; (209 to 212) Ice-pressures on Lake Balaton; (213) Ice-pressures on Molo Siófok.

Persia, etc. **Sarre.**

Eighty-five Photogravures (with a route map) taken during Dr. Fr. Sarre's expedition through Transcaucasia, Persia, Mesopotamia, and Transcaspian region, 1897-98. Berlin, 1899. Verlag von Dietrich Reimer (Ernst Vohsen). *Price* 18 *marks. Presented by the Publisher.*

This album contains photogravures of the people and scenery of Transcaucasia, Persia, Mesopotamia, and the Transcaspian region. They are accompanied by explanatory letterpress, and a map on which the routes followed by Dr. F. Sarre are laid down. The titles of subjects are given below—

Transcaucasia.—(1-3) Delijane; (4) Chibukli pass; (5) Armenian peasants of the Chibukli pass; (6) Malakan village on Lake Sevanga; (7) Lake Sevanga; (8, 9) Erivan; (10, 11) Nakhchivan; (12) Julfa on the Aras (Araxes).

Persia.—(13) Tabriz; (14) From Tabriz to Ardebil; (15, 16) Ardebil; (17) From Ardebil to Zindjan; (18, 19) Zindjan; (20) Weramin; (21) Teheran; (22) Kum; (23) Kum market-place: snowstorm between Kum and Rahgird; (24, 25) Rahgird; (26-30) Sultanabad; (31-35) Dizabad; (36-38) Farasbhe; (39) Kangavar; (40-42) Sahna; (43, 44) Rock of Bisutun; (45) between Bisutun and Kermanshah; (46-48) Kermanshah; (49) Tak-i-Bostan; (50, 51) Hassanabad; (52) Miantak caravanserai; (53) Miantak; (54, 55) Scripul; (56) Tak-i-Girra pass; (57) Kasr-i-Shirin; (58) Turco-Persian boundary, Turkish Zaptieh.

Mesopotamia.—(59-61) Haditeh; (62) Anah: The caravan on the banks of the Euphrates; (63) Anah; (64) Salihieh; (65) ruins at Rahaba; (66) Rahaba.

Syria.—(67) between Deir and Kabakib; (68) Kibla, from Bir Kabakib; (69, 70) Tadmor; (71) between Tadmor and Karietein; (72) Karietein; (73) between Karietein and Damascus.

Transcaspia Region.—(74) On the railway platform at Askabad; (75) On a railway station in Bukhara; (76-84) Bukhara; (85) Samarkand.

Victoria. **Caire.**

Sixteen Photographs of Victoria. By N. J. Caire, Victoria. *Presented by Dr. T. Hodgson.*

The subjects illustrated by this series include forest scenery and the incidents of life in the bush, as will be seen by the following list of titles:—

(1) Wombat gully, Fernshaw; (2) cutting up a giant tree, Fernshaw; (3) Syncona hill, Black Spur, Fernshaw; (4) Fairy scene, Black Spur, Fernshaw; (5) Scene near Lilydale; (6) Bush and hut, Gembrook; (7) Tree-felling, Gembrook; (8) Coal-mine, Yarragon, Gippsland; (9) Bush and huts, Gippsland; (10) Giant tree at Nurim, 48 feet girth, 325 feet high; (11) Pass top of Mount Strezlecki; (12) Fern bower, Hasledene, Gippsland; (13) Sundowners who live in hollow tree; (14) Lubra's camp; (15) Scene on the Yarra at Coranderrk; (16) "Too late!"

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

SKETCH MAP OF THE

CHINESE SHAN STATES

OR

SIP SONG PANNA

from a drawing by

FRED. W. CAREY.

Scale of Miles

Nat. scale 1:1000 000 or 15·8 miles = 1 inch

Franco Chinese Frontier (settled 1897.)

Anglo Chinese do (not yet defined.)

Districts in the Sipsong Panna in Egyptian Capitals

Routes & Likiang stations.

Branch Custom House stations thus I-wu.

30' 99 30' 100

30' 22

Cotton

Boundary undefined

MENG LEM

CHEN PIEN TING

LO HEI

Chen Pien

To Shun-ning & Mien-ning

Ta Ya

Meng Lien (Meng Lem)

Pan Chung

Meng Mang

Meng Ngang

BURMA

Boundary undefined

MENG

Meng

Nam Lam

Ta Lo

Meng Ma

Nam Lui R.

Meng Wak

KIANG TUNG

Kiang Tung (Meng Keng)

BRITISH SHAN

30' 100

Irawadi

Mekong

Tali

Yang-tse-kiang

KWEI-CHAU

Teng Yueh

YUN-NAN

Shun-ning

Hsin-hsing

YUN-NAN

Bhamo

Chin Tung

KWANG-SI

Salwin

Wei-yuan

Talang

Mengtze

Kai-Hua

Ho Erh

Red R.

BURMA

Sinmao

Black R.

Mandalay

Mong Mong

Kiang-hung

TONG-KING

Lang-son

Kiang-tung

Lang Thuong

HANOI

Nam U

Salwin

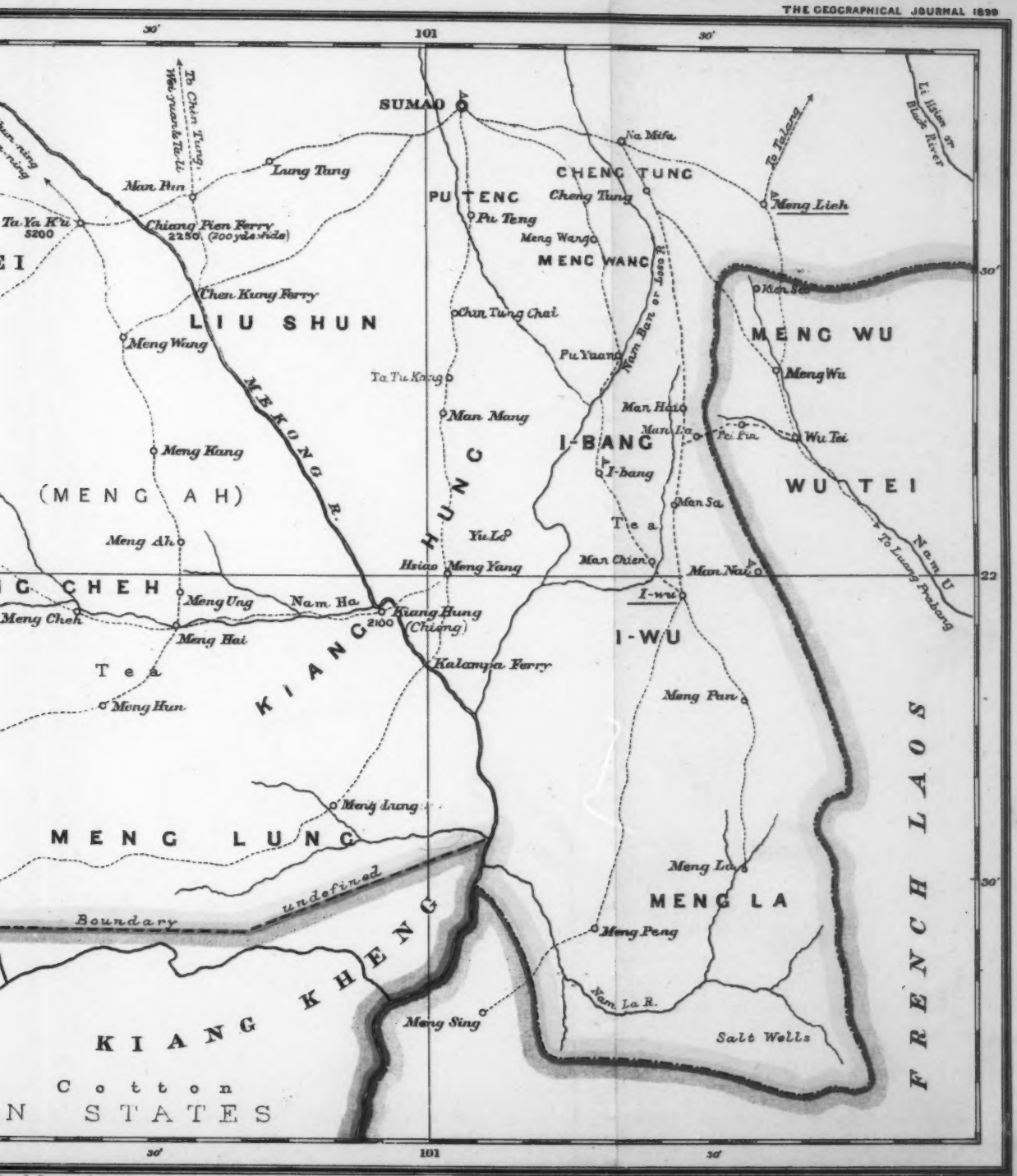
Me Kong

Luang Prabang

Gulf of Tong-king

Chieng-mai (Zimme)

Published by the Royal



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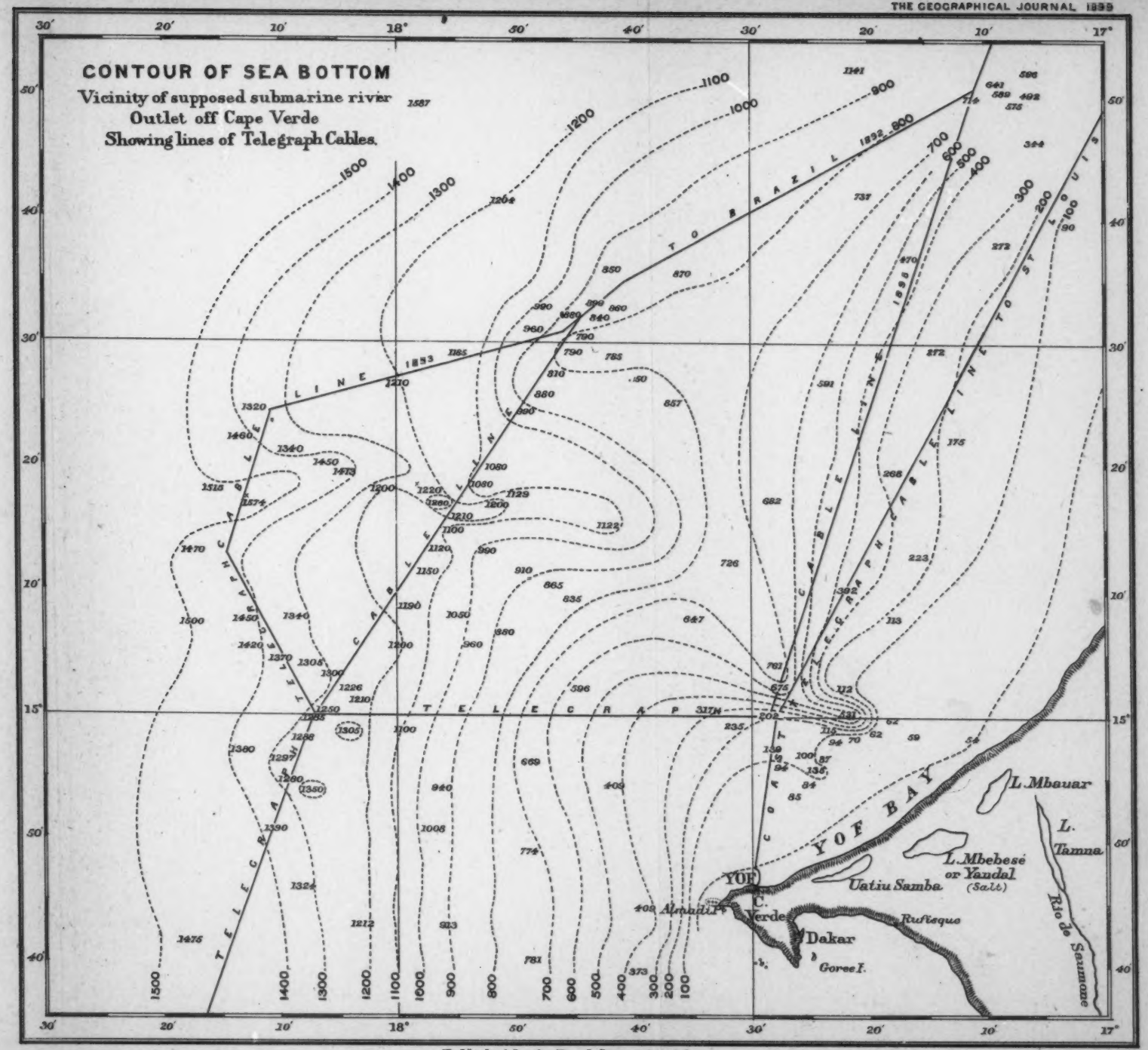

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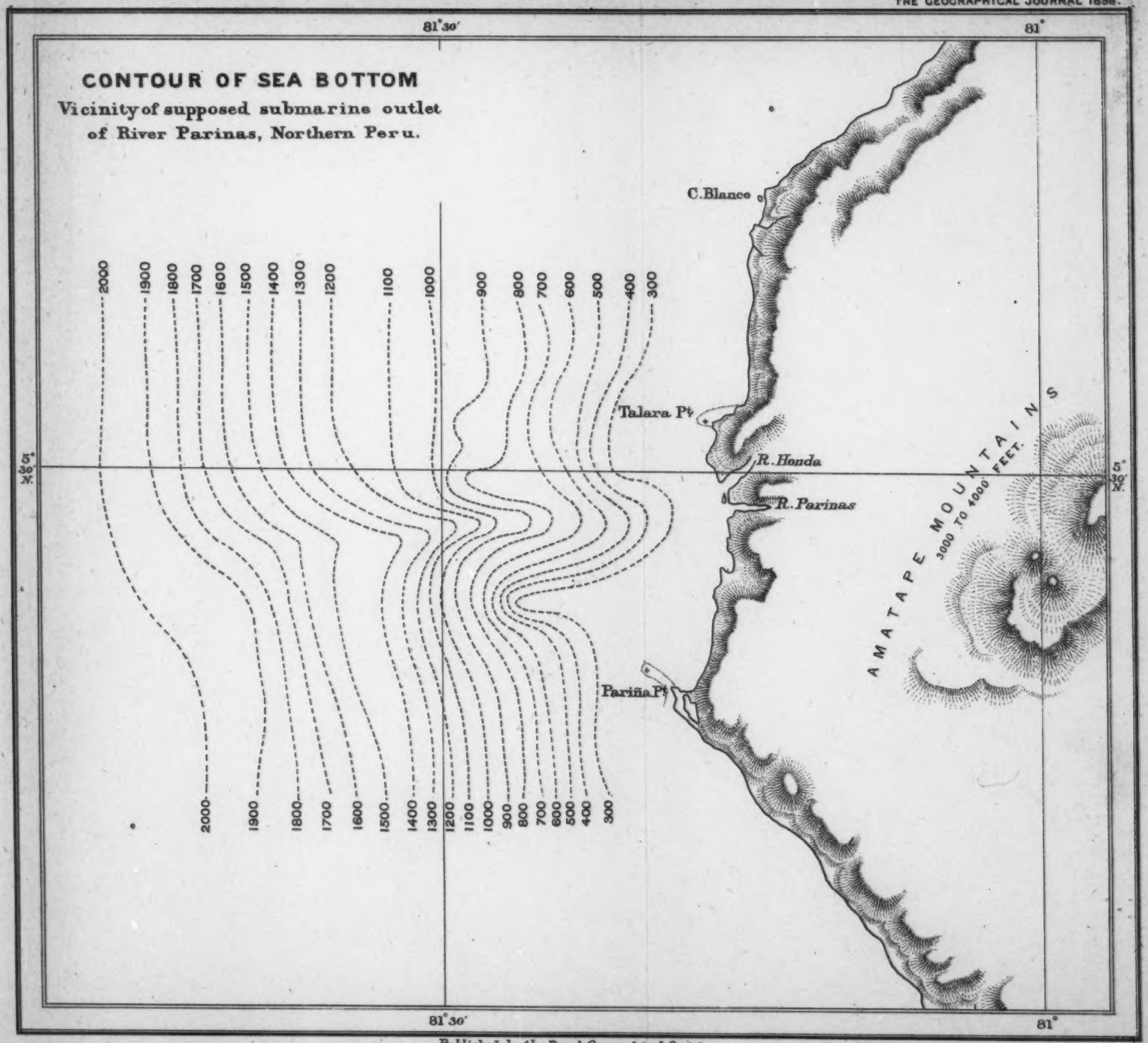

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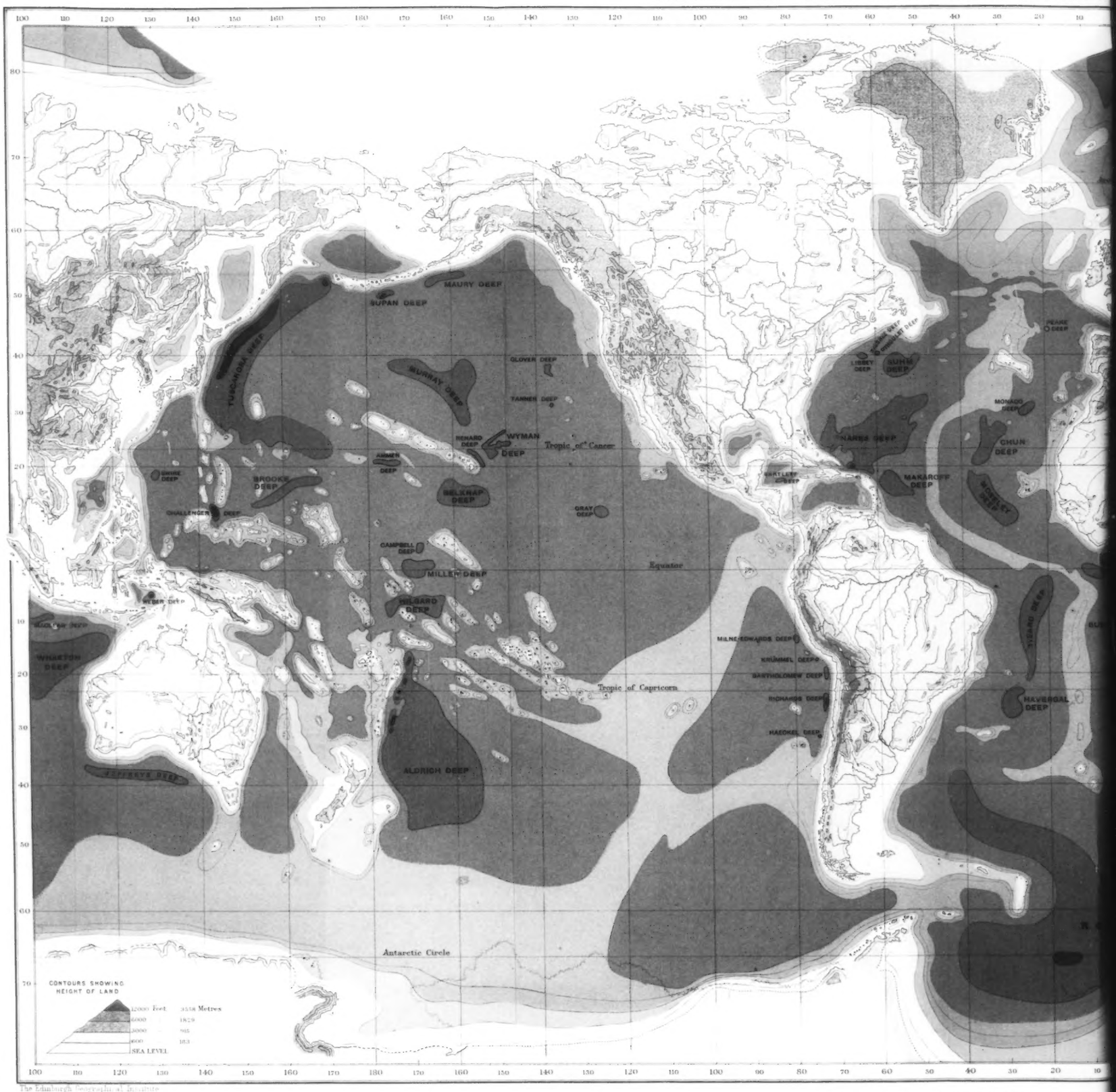
BATHYMETRICAL CHART OF THE

SHOWING THE "DEEPS" ACCORDING TO SIR JOHN M



The Edinburgh Geographical Institute

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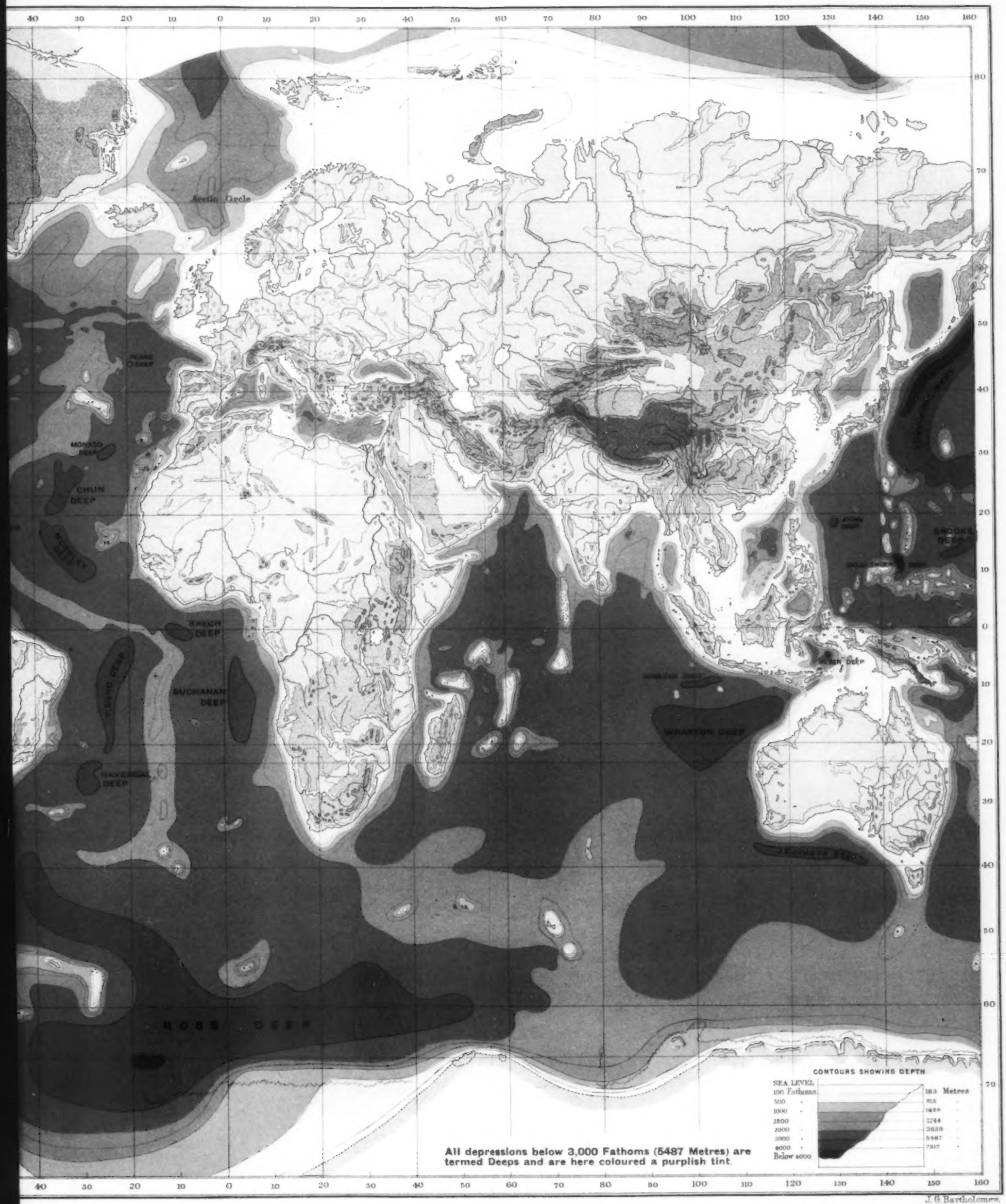
RT OF THE OCEANS

DING TO SIR JOHN MURRAY



J. G. Bartholomew.

...graphical Society.